Volume 25. JUNE, 1911. $3.00 a Year.
Number 2. $1.00 a Number.

JOURNAL

CLYDE POTTS,
30 CHURCH STREET.
RECEIVED
SEP
RECD ANS DATE

OF THE

New England Water Works Association.

ISSUED QUARTERLY.

PUBLISHED BY

THE NEW ENGLAND WATER WORKS ASSOCIATION.

715 Tremont Temple, Boston, Mass.

Entered as second-class matter September 23, 1903, at the Post Office at Boston, Mass., under Act of Congress of March 3, 1879.

Copyright, 1911, by the NEW ENGLAND WATER WORKS ASSOCIATION.

OFFICERS

OF THE

New England Water Works Association.

1911.

PRESIDENT.

ALLEN HAZEN, New York, N. Y.

VICE-PRESIDENTS.

J. WALDO SMITH, New York, N. Y.
LEONARD METCALF, Boston, Mass.
MICHAEL F. COLLINS, Lawrence, Mass.
IRVING S. WOOD, Providence, R. I.
FRANK A. McINNES, Boston, Mass.
MORRIS KNOWLES, Pittsburg, Pa.

SECRETARY.

WILLARD KENT, Narragansett Pier, R. I.

TREASURER.

LEWIS M. BANCROFT, Reading, Mass.

EDITOR.

RICHARD K. HALE, 85 Water Street, Boston, Mass.

ADVERTISING AGENT.

ROBERT J. THOMAS, Lowell, Mass.

ADDITIONAL MEMBERS OF EXECUTIVE COMMITTEE.

WILLIAM E. MAYBURY, Braintree, Mass.
EDWIN A. FISHER, Rochester, N. Y.
JOHN J. KIRKPATRICK, Holyoke, Mass.

FINANCE COMMITTEE.

GEORGE H. FINNERAN, Boston, Mass.
ALBERT L. SAWYER, Haverhill, Mass.
JOHN H. WALSH, East Hartford, Conn.

THE ASSOCIATION was organized in Boston, Mass., on June 21, 1882, with the object of providing its members with means of social intercourse and for the exchange of knowledge pertaining to the construction and management of water works. From an original membership of only TWENTY-SEVEN, its growth has prospered until now it includes the names of over 700 men. Its membership is divided into two principal classes, viz.: MEMBERS and ASSOCIATES. Members are divided into two classes, viz.: RESIDENT and NON-RESIDENT,—the former comprising those residing within the limits of New England, while the latter class includes those residing elsewhere. The INITIATION fee for the former class is FIVE dollars; for the latter, THREE dollars. The annual dues for both classes of Active membership are THREE dollars. Associate membership is open to firms or agents of firms engaged in dealing in water works supplies. The initiation fee for Associate membership is TEN dollars, and the annual dues FIFTEEN dollars. This Association has six regular meetings each year, all of which, except the annual convention in September, are held at Boston.

Table of Contents.

PAGE

Some Difficulties in the Purification of Water Supplies. By Dr. Gardner T. Swarts 191

Report of the Committee Appointed to Investigate the Conditions under Which Extensions of Main Water Pipes are Made 212

The Reforestation of Watersheds for Domestic Supplies. By F. W. Rane 234

Practical Forestry for Water Works. By E. S. Bryant 243

Desirable Pressure at Hydrants. By E. V. French 247

Proceedings:

Special Meeting, April 12, 1911 278

Address by Mayor Lathrop of Springfield 279

Executive Committee:

April 12, 1911 284

New England Water Works Association.

ORGANIZED 1882.

Vol. XXV. **June, 1911.** **No. 2.**

This Association, as a body, is not responsible for the statements or opinions of any of its members.

SOME DIFFICULTIES IN THE PURIFICATION OF WATER SUPPLIES.

BY DR. GARDNER T. SWARTS, SECRETARY OF STATE BOARD OF HEALTH OF RHODE ISLAND.

[*Read December 14, 1910.*]

I trust that the statements I may make will be considered merely as the result of experience in coming in contact with this question of purification of water in various capacities, — for instance, as secretary of a board of health, as the chairman of a committee on filtration of the common council for three long-drawn-out years, as a bacteriologist, and from constant contact with the strong and influential opinions of the best bacteriologists in Massachusetts and throughout the United States. The result of those experiences has been to convince me that a person who undertakes to secure the purification of a water supply is very much like the paternal member of the family who is sent to Boston to procure a Christmas present for the little daughter to present to the little boy. He finds himself on Tremont Street before the dazzling array of mechanical toys, and he wanders up and down trying to determine which will be the most satisfactory, which the most durable, which possesses the best mechanical qualities, and which he will best be able to operate when he takes it home. And then he reflects on the fact that Sarah has given him a whole nickel with which to make the purchase. That is the first difficulty most persons meet who undertake the purification of a water supply, — and I have passed through all the agony.

Assuming to be skillful engineers and practical men experienced in water matters, and looked up to by our learned legislators as men who will give them the best advice and the best and most economical methods, we find ourselves in an awkward position. We look over the field and we find that there are certain devices which are provided to take care of the particular water with which we have to deal.

You are all aware of the fact that water is water; but it is a little different water in one place than it is in another. Those of you who have traveled through New England and seen the limpid streams passing over the waterfalls into the ponds where the fish sport themselves in the clear water, cannot realize the difficulties and obstacles which are met when one comes to deal with waters in the western and central sections of the country, which are creamy to the extent of depositing perhaps a third of a glassful of sediment in the glass upon the table.

I can recall going to Chicago in my early days and seeing that condition, and all of you know the condition of the Mississippi and Missouri rivers. So, when you come to consider the question of the purification of water, you have many little problems to contend with at the start.

The difficulties which one encounters in this particular way may come after a perfect decision on the part of the engineer, or possibly of the person who has secured the contract for the filtration plant. A contractor takes up the question with the town council, and the thing is about as good as concluded that with his system he can take care of the water. But immediately objection is raised by some learned physician, who comes forward and exclaims, "Oh, but you are going to put chemicals into the water. I understand that mechanical filtration is not simply agitation of the water, or agitation of the sand through which the water passes, but you are going to put alum in the water, and don't you know what is going to happen then? Every citizen in the town will be ossified within three months! Every child that is coming to birth will come before its time!" Well, the horror of that in large headlines in a good solid newspaper makes a stir, and immediately the contractor is put in the background. These are personal experiences, gentlemen.

Then comes to the front those who have had long and varied and satisfactory experiences with perfect experimentation in the lines of sand filtration, which seems so simple in its processes, so easy to lay out and to operate, and their engineer has his hearing, and the good old doctor rises again and endorses this system with great gusto, proclaiming that this is Nature's method, that that is what we like to see, — the water carried through the earth and brought out pure and clear after being treated by these natural processes; not reflecting that the purest water he can think of is the old spring water on the farm, which he knows bubbles up from a depth of 100 or 200 ft. below the surface, and which he must recognize, as a man versed in chemistry, — or at least who should have been when he got through his primary course, — in coming from that depth has come in contact not with alum alone but with many other chemicals, and contains many elements which if analyzed out and given a name would make as startling headlines in the daily paper as the terrifying alum.

But that is something which is way back, and especially in our New England states, where we are somewhat conservative,— that is a very good recommendation to the people. They want what is old fashioned, they want what their grandfathers had, — the same old wells which have been used from generation to generation, accumulating in all the years the goodness of the families which have gone before. Likewise they know that the streams which are coming down from the mountains and the hills are also increased in their value by the manufactories which have been placed upon their banks, the waste from which is allowed to enter the stream. It is the same old stream, and they think it is the same kind of water and that it can be used with safety.

It is a hard matter to argue sense into some people sometimes, especially if they are of the old New England stock. We are of New England stock down in Rhode Island and we still have a good deal of that spirit which was brought down by the Dissenter, who couldn't get along very well with Massachusetts people and who so saturated the soil of our little state with independence that each individual citizen, no matter if he is an Italian of two weeks' life there, is an independent law unto himself, — and you can imagine what the old veterans are. Think, therefore, of the

difficulties we have when we ask them to adopt some system for purifying water, and then think of the difficulties we have to surmount when we are confronted with these various devices by which we are going to purify it. Suppose, for instance, we decide that we will take up sand filtration. We call upon the best outside engineers to tell us how it shall be done, and they approve a certain device. The local engineer understands his business; the outside engineer who is called in is going to earn his money, and he does, and he will recommend sand filtration as the best, perhaps as the best under the circumstances, inasmuch as the prevailing opinion in the council seems to deflect that way.

Then there is one particular thing which is raised as an obstruction, and that is that sand beds are objectionable because they may freeze up. But it is said in reply that that is not a thing to be thought of in New England. Water a foot deep anywhere, perhaps, beyond the line of Pennsylvania will freeze, but here in New England, where a sand filter is to be put in, it isn't necessary to cover that filter and add to the expense. The experience we had down in the little city of Providence was that while we started with the idea of paying $200 000 for a filtration plant, a filtration plant of sand which was to be uncovered, it has now been discovered as one which would freeze even in New England and needed covering, and it is now beautifully covered, sanded, loamed, and grassed, and it has cost us only $600 000. That is one experience. It is sometimes worth while to pay your money for what you learn. Of course at first it was simply the engineers, but the contractor has come across other difficulties. He meets with commissioners — I won't say what kind of commissioners, nor that it has been my experience, but there are certain commissioners whose thought is diverted at times by influences which may never appear upon the surface. I haven't had that experience; but evidently somebody else may have had.

However that may be, having overcome the difficulties of the commissioners and of the committees of the citizens, there is the engineer, who is always alert that everything shall be put in correctly, but he has certain devices of his own that he thinks ought to be introduced, and they are introduced through his influence, possibly to the detriment of the plant which was prop-

erly laid out by the original engineer, whether it be a sand or a mechanical filter. Then in some states you come up against the board of health. In Rhode Island the board of health is merely advisory; but in other states, — I think we are in one of those states now, — and states like Ohio and Indiana, and all out through the West, they are alive to the fact that there are some new ideas.

Then there is the experience, as it comes to daddy after he comes home with the nickel purchase and regrets, the moment he sees the children with the toy, that he did not chip in a quarter and get a better instrument. But with us the toy is the plant, and the plant is there, and we have got to do the best with it we can. And what is the best? My innocent experience in these things has shown me that no matter how good the plant is, and how well it is put in, it will not work of itself, as the toy did on Tremont Street. It has got to have a little supervision. You have got to pay a little money, not for the extremely expert knowledge, but you have got to pay a little money for horse-sense, and it is mighty hard work to find it, — just plain, common horse-sense, from the head of the department down to the man who shovels the coal.

Now, the operation of a plant looks simple. It is nice to build cement masonry now, for we can make pretty structures, and can use most any shape or form and get any strength we need, we can put in centrifugal pumps and pipes and what-not indefinitely, and all manner of devices which on paper in the engineer's office look fine and when they are erected start out nicely. But, like the toy in the Christmas carol, the thing comes to a stop, or, rather, some of the wheels don't go around. I am not speaking of any particular plant, you understand; I am simply speaking of experience with plants in general. The same may be true of other forms of filters beside mechanical filters.

When those wheels come to a stop, some one has got to find out why they have stopped. And it has been, I think, the practice of most of those companies who have their business interests at stake to look after these plants and leave directions at least in typewritten form how, even with a little mechanical experience, the plant may be run, chemically and bacteriologically. It seems to me to be obvious that any one who wishes to continue in the

business of putting in these plants must follow up the experiences which result from their use. And those experiences have been in many cases most interesting. Where a device will accomplish one thing in one locality, the same device in another locality will not accomplish the same thing. Perhaps the same water is used, perhaps the same instructions are given; but those of you who have had experience in water matters know that with a freshet, or with a hard rain, in the average stream what is the water of to-day is not the water of to-morrow. What takes a certain amount of chemical to accomplish certain results in purifying the water, so that the proper effect will be produced and proper filtration follow, may not be the same to-morrow. So it may be given out to those who are to run the plant that they have a water of such a quality, and that they should use a certain quantity of coagulant, which in this case we will call alum, and things should run as they ought to. But a little while after, being on a stream which is perhaps influenced by mechanical industries, the water begins to get too acid. There may be jewelry establishments, there may be iron works, on the stream. No one at the works knows that the water has changed in its acidity, but it is discovered that the color, which previously was below 10 on the graded scale, has run up to 40 or 50 without any particular reason. It is discovered, too, that the bacteria which have come from the filter in the filtered water ranging 50 as against 3 000 in the stream are now running into the hundreds in the filtered water. It is a puzzle to those who are managing the plant, and the question then arises what is to be done? Simply a little horse-sense given out in the beginning, and absorbed by the individual who is running the plant, corrects these matters.

It is necessary, therefore, that there should be some control of plants by an authority which is subservient to the public, a commission of water control, or, as is our experience in most states, the board of health, who take and have, as in Massachusetts, the control of the water supplies which are to be delivered to the constituents of the board of health. Unfortunately in our state we have no such control. It must be remembered that many of these plants are placed in operation under the pernicious influence of an individual owner, a private supply, over which the

public has not control; or it may be that a city council's treasury runs a little low, and there is a cut on the alum; and there comes another question, — as to the quality of the alum. Certain alum was given in the beginning and it worked nicely; certain sand was given and that worked nicely; but for economy's sake there is a curtailment in the price of alum. Along comes an alum producer, and he offers a barrel of alum at very much less price than a previous purveyor of that article, and we don't get the same results; we are not getting the same amount of alum.

Furthermore, it may be that after the alum has worked nicely it is found that the water has become too acid and it is necessary to add a certain amount of alkalinity. Now, to the difference in the quality of the alum may be due the difference in the amount of alkalinity which is added, in order that the alum may bite and have its agglutinating effect upon the organic matter. Otherwise the *Schmutzdecke*, the covering upon the filter sand, does not form, and the result is that water comes from the filter which is not suitable to drink, nor for mechanical, bleaching purposes, or steam production, all through a little slip, perhaps; and that slip, my experience has shown, has come either through good-will, political or other pernicious influence — but most generally good-will — whereby old John, who was the engineer for the last quarter of a century, has pumped the water and kept the machinery well oiled, is put in charge of the mechanical plant and told to run it. Things may run wrong for awhile, but no one has the courage to dismiss him. At last a pension may be found for him and a new engineer may be put in who has a little life and has a little common-sense; instructions are given him which are followed up and controlled by the chemist or bacteriologist, whoever is in authority, and by those who are above the chemist or bacteriologist who has control, as indicated in regard to water commission controls. Under these conditions proper results can be obtained, and a clear, pure water can be furnished to the people.

All these difficulties and troubles, or others like them, and the sad experience which comes with them, — and which comes in nearly every plant because the water varies and the influences which control the plant vary, — may come to you in the varying conditions of sand filtration. Perhaps I ought not to speak about

sand filters here, where I am on their native heath, so to speak. Perhaps I ought not to say a word with regard to them, but I am simply telling now of my experiences. With sand filtration you have, perhaps, an ideal condition, if the conditions are favorable, — a water which has not too much sediment in it, plenty of good sand in the immediate vicinity or within a short haul, plenty of area which is not expensive, an experienced man to control the plant, and good workmen to work under him. But, unfortunately, here politics come in. There must be fifty men hired where twenty would do the work, and that fifty are usually of the quality, or may be of the quality, which is not desirable even for shoveling sand. And yet it is expected that with these men the sand, which must be removed from the surface of the beds, will be removed nicely and carefully in order that the surface of the beds may not be broken up and disturbed. It can be done, but it requires supervision and it requires experience on the part of those who have control of the plant. When I look upon a sand filter plant in New England, and compare it with one of the mechanical filters, it makes me think seriously of ancient Egypt, where the water was raised from the river bucket by bucket, and the manual labor which was required to introduce the water into a town or city was out of all proportion. If mechanical devices were introduced, as they are in mechanical filtration, with the same difficulties and the same chances, it would seem a little more Americanized and a little less heathen. But the heathen are waking up, I understand, for mechanical filtration plants are now being placed in India, Egypt, and Japan.

Now, after one has gone through all this enjoyment and pleasure of seeing the operation of his toy, lots of little difficulties come up. There is a question which arises as to the method of cleaning the bed, whether to devote three or four whole days or a week to cleaning a sand bed, and then take a week or so for washing the sand before it is returned to the bed, and then have all the labor to perform of carrying the sand back to the bed. Then there is the difficulty of understanding why at certain times when our mechanical bed is working smoothly and nicely, suddenly there is a " fluffing " of the sand and an inoculation of the whole bed which no one can understand. Those are matters which come up

and are extremely interesting, and as they come to us at times we take them with the feeling that we are glad to see something different in order to have the pleasure of studying it out. There is the possibility that your alum feed is put in at the wrong place, so that there is not sufficient time for coagulation of the alum, and the organic matter in the water is not long enough in contact with the alum.

But, after all is done and told, we get our beautiful white water in our sump basin, we have alumed it, we have hypochlorited it, and we pass it into our reservoirs in that state, and suddenly there are telephone calls from all parts of the city to the health department, " What is the matter with the filtered water? What kind of chemicals have been put into it? It smells as if all the dead clams on the shore had got into your reservoir." Of course we know what to do, but we are modest, we are very innocent, and we simply say, " Those are the beautiful organisms we call algæ. If you could only see the beauties of these algæ under the microscope you wouldn't smell a thing in the water." But the people have no microscopes, and they don't care for microscopes; they simply know that the water stinks, and if something isn't done about it they think the whole population will die, and there is trouble for the health department, and we have to quiet their feelings. They say, " How long is this going to continue? " We reply, " Well, these crganisms usually live about two months, sometimes three, when they die out, and then the thing will stop. And it will stop all of a sudden, too; you will be surprised and interested." Well, they haven't any interest in what is going to happen in three months; they are interested in what is happening just now. So our friend comes to the front with his chemical knowledge, and he takes a bag of sulphate of copper and goes up and down the reservoir — and he does it early in the morning when nobody else is looking on, for fear the reporters will get hold of it and say that there is more doping of the water going on; and he succeeds in bringing about a beautiful result. In a couple of days the algæ have disappeared, and the odor has disappeared, except what may be left in the pipes. But in a few days there is more trouble. An examination of the water shows that while we have killed off the asterionella, or some other organ-

ism, another little "bug" has come to the front which can live where the other one can't; but we haven't quite so much to apologize for because there is now a geranium or lemon odor, yet that is sufficient so that the users of the water are disgusted with the plant.

We have no control of that at the present time. It is impracticable to cover over the reservoirs so that this clear water, in which the organisms grow with so much facility, can be protected from the rays of the sun. Therefore, we have got to find out — and that is something which all of us ought to put a hand to — how to prevent the algæ getting in to start with, how to prevent the little seeds from going from place to place, and if it is possible to kill them out in one place so that they will not be blown to another. Here arises a line of study which will be held open to those of the coming generation. We had hoped it might be finished here with us, but unfortunately it apparently will not be.

There is one thing with regard to mechanical filtration which interests me, and it is not clear to my mind, although those who have charge of the introduction of these plants can explain it to you very lucidly, and that is the difference between the air-wash, and water wash with the mechanical agitation of the rake. I have seen both plants in operation and have watched the rakes go "round," and personally I can see very little difference. For instance, I assume that the air-wash is the forcing of air underneath the bed, which has settled down or choked after the filtration has been completed, so as to break up this *Schmutzdecke* or covering of coagulated sediment which has formed on the top. The wash water from below carries off this surface of decayed material, the bed is then allowed to settle down to its normal state, the sand having been cleaned, and the operation again goes on. In the mechanical or rake pattern, the tanks instead of being oblong are circular and revolving rakes cause an attrition or contact of the bars against the sand, and grains of sand against each other, theoretically scouring the sand more thoroughly than the air-wash.

But with all the air-wash there comes at times a condition of the "fluffing" of the bed. The bed seems to be spongy, and for no particular reason. The grains of sand do not seem to be covered with any particular slime, but there seems to be softness

to the bed which does not allow perfect filtration. Then we begin to say that the air-wash is at fault, until we find that in the same kind of a plant the beds with the rakes begin to fluff also. I shall not attempt to tell you why this is, because I do not know. There may be others here who are experts in the work who can tell you, and they will tell you, perhaps, for a consideration, or out of the kindness of their hearts. At any rate, it is a thing to be found out, and is extremely interesting.

Now, gentlemen, these are some of the experiences which have happened to me as an individual, and as an official of a board of health. Possibly some of you may have had such experiences, and many of you will have them in the future; but pray, when you go to buy your plant, whether it be sand or mechanical, stop and think whether it is a smooth waxed floor that the toy is going to be run on, or whether there is going to be a carpet there; stop and think whether it isn't policy to take twenty-five cents out of your pocket and spend it rather than to get a cheap toy. Go to those who understand these things, to the engineers who have had experience. They have different opinions among them, but they all have one common source and fount of knowledge, and they have the same opinion, really, although they may express it a little differently. They can tell you, and you ought not to try to use your correspondence course in this line, for it will be expensive. Go to those who understand the work and have been through all these troubles. I am not speaking of those who sell the plants, or those alone who have the knowledge to tell you how to select a particular plant or how to care for a particular water, but go and learn from the experience which comes to you from such sources as the State Board of Health of Massachusetts, which has devoted years and years to a study of the questions of filtration, and whose tomes and volumes, which seem to you to be endless in the way of figures and lines and columes, have been the source of valuable knowledge which has been acted upon throughout the whole world, for the benefit of civilization and for the benefit of all those who have taken up this question.

Now, gentlemen, you are all water-works men. You know how the pumps work, you know how the filters ought to work, you

may have had some of these experiences or you may have had others. But all I can ask is that you will take the statements which I have given to you to-day and think them over before you attempt to indulge in the luxury of a five-cent toy. Then I think, perhaps, our time will have been fairly well spent.

DISCUSSION.

MR. GILBERT H. PRATT.* Dr. Swarts's experiences and mine have been linked together for the last five years, and in that time I think I have met nearly all the difficulties that he has spoken of. The thing resolves itself, in a few words, to the concluding remarks that the doctor made, and I would express it in this way: When you want advice, go to a good doctor; and when you think that you may have some trouble the matter with you, don't try to fix yourself up.

I wish to emphasize the point that the doctor made, that waters vary greatly even in the same locality, and the same waters will vary to a decided extent from month to month, and at times from day to day. I have had experiences in connection with municipal water works and in consultation work I have had to do with mill plants, where I have had that fact brought very forcibly to my notice, — where waters which might be of a certain character at one time, to use a crude expression, " went all to pieces," and could not be handled by the previous process, — not that the essential process was at fault, but in some little point some little change had taken place.

The variation in the flow of the stream as to its alkaline contents is a very serious proposition which keeps coming up all the time. In one case which I have in mind, a mill plant had operated beautifully for years, and then things went all to pieces so far as the output was concerned. All that was needed in that case was the introduction of a very small dose of carbonate of soda, and the plant was on its feet again, turning out the same bright water.

MR. HARRY W. CLARK.† I have no prejudice against mechanical filters in their right place and if they will do the work

* Chemist, Rhode Island State Board of Health.
† Chemist, Massachusetts State Board of Health.

that other filters will. You must remember, however, that the primary object of a health board when advising in regard to water filtration is generally to be sure that the health of the people is to be benefited by such filtration. Of course there are times when the only object is the improvement of the physical character of a water. Obtaining a nice-looking effluent is not often the first thing to think of, however, important as that is. The first thing to be considered is, generally, will filtered water improve the health of the people using it?

I would like to call your attention for a few minutes to an article written recently by Dr. Sedgwick, of the Institute of Technology, and Mr. McNutt, a health officer in a New Jersey town. This article was published in a late number * of the *Journal of Infectious Diseases*, and is a description, with illustrations, of what the authors call the Mills-Reinke-Hazen theory, which is that, wherever slow-sand filtration plants are introduced, not only are the deaths from typhoid reduced, but the total number of deaths from other diseases also. Mr. Mills, the engineer member of the Massachusetts State Board of Health, discovered this to be true when studying the death records of Lawrence after the introduction of sand-filtered water. Compared with a number of years before the introduction of this water, the deaths of the city decreased after the construction of the filter 15 or 18 per cent.; that is, the death rate went down from something like 23 to 16 or 17 per 1 000; I do not remember the exact figures. Now, in this article by Sedgwick and McNutt, the results upon the health of the people of the construction and operation of what they call eight sand-filter plants, are given, the results being, of course, shown by deaths from typhoid fever and total deaths from all causes. In the article they speak of the great reduction at Hamburg, Lawrence, Albany, etc., where sand-filter plants are in operation, — and they include Watertown and Binghamton, N. Y., in the list of sand filters also. As a matter of fact, however, Watertown and Binghamtom have mechanical filter plants. Sedgwick and McNutt do not seem to realize this, and call attention to the fact that these two plants, namely, those at Watertown and Binghamton, do not follow the general rule of sand filters in the reduction of the

* Vol. 7, p. 489.

death rate of the community they serve. If you will study broadly the reduction of death rates at various places after the introduction of sand filters or mechanical filters, you will see clearly, I believe, that almost invariably when a good sand filter is put in, not only are typhoid and typhoid death rates very materially reduced, but the total death rate also, and that following the introduction of mechanical filter plants of the best design, the death rate in communities served by them is not reduced as distinctly as by slow-sand filters. I do not say that there may not be some other cause than the different methods of filtration, and that there are not exceptions to the general rule, but the statement made is true. So I wish to repeat that the first province of a health board is to advise in regard to the health of the people, and in the subject under discussion the probable effect upon their health of a proposed filter plant. When mechanical filters can show as good results as sand filters in this respect, there will be more to be said in their favor. Of course I know about a lot of these mechanical filter difficulties in Rhode Island and elsewhere, and I do not mean to say that there are not difficulties often in the operation of sand filters. I know also, as Dr. Swarts has said, that mechanical filters are in operation in India, Japan, Egypt, and other foreign countries. I think, perhaps, they ought to be operated there first, for the old reason of "trying it on the dog." Personally, I like to see the water that comes from a good mechanical filter plant. It is generally clear, colorless, and attractive. There is no doubt that many people like it and I do not doubt that mechanical filters of modern construction when well operated with the waters to which they are best adapted, produce a satisfactory effluent at many places. With the clear, soft waters of Massachusetts, however, free or nearly free from turbidity, mechanical filters appear to be unnecessary, and we must not forget the first reason for filtration of polluted water, — improvement of the health of the community.

Mr. Robert S. Weston.* When we consider the difference between the point of view of those who favor mechanical filters and that of those who favor sand filters, we ought also to realize

*Sanitary expert, Boston, Mass.

how much nearer these points are to each other to-day than they were a few years ago. We can remember, for instance, when a sand filter which operated at a rate of 2.6 million gallons per acre per day was considered to be the standard, and when the mechanical filter companies were advertising and selling filters based on a rate of something like 250 to 300 million gallons per acre per day. Then we had a series of studies by the Massachusetts State Board of Health, by Mr. Fuller and others, which has resulted, I think, in reducing the rate of mechanical filters to something like 125 million gallons per acre per day; and increasing the rate for sand filters to from 6 to 10 millions gallons per acre per day. Thus the rates of filtration are approaching one another. It operates, of course, to reduce the difference in construction cost between these two filters.

Then, again, there has been a great improvement in the method of cleaning and operating sand filters. It is a great disadvantage in the operation of sand filters under existing conditions that such a large crew is necessary to scrape the sand beds. This is especially disadvantageous when the sand has to be cleaned frequently, which is the case with a water which is between the clear type of water, to which sand filters are especially applicable, and the turbid type, which is, perhaps, most readily purified by mechanical filtration. In such cases, where scraping must occur frequently, the labor cost is very high, thus assisting a movement which, I think, is towards the mechanical type of filter. The first step in that development was taken, I think, at Lawrence, where the scraped off sand, instead of being transported in wheelbarrows to the sand washing floor, was removed by ejectors. Subsequently, at Washington, the sand was removed by ejectors, washed, stored in bins and then carried back by carts and men. More recently ejectors have supplanted the carts, and finally a machine has been devised for cleaning the sand in place, by which the sand is taken off of one filter by a scraping machine and passed through an ejector and washer into an unused filter.

Another step in this direction is the Blaisdell system, where the sand is washed in place by what is practically a traveling hydraulic rake. It traverses the surface of the sand, and by means of hydraulic jets reaching down into the sand transforms

successive portions of the area into mechanical filters for the time being, as far as the cleansing process is concerned.

Then another way in which I think the sand filter is imitating the mechanical filter is in the arrangement of the pipes and rate-regulating devices. The New Haven filters were the first step in this direction. The sand filters instead of being placed along both sides of a court were arranged on two sides of a gallery, like mechanical filters, with the piping all exposed. In this way I think the sand filter has been improved by the presence of the mechanical filter, just as the old system of dosing with mercury and drugs was improved by the promulgation of the homœopathic theories of medical treatment. Likewise both slow sand and mechanical filters may be succeeded by systems possessing the excellencies of both, for the more one studies the facts the more one realizes, first, that there is no one type of filter suited to all types of water; and, second, the two types of filters which we call slow sand and mechanical are a great deal nearer together in their design than they were fifteen years ago.

Another point, mentioned several times before, may be emphasized. It is the value of appearance. When one advocates a water supply, especially a purified water supply, one must promise water which is agreeable, or people will not drink it. If they will not drink the water they will go to springs for their drinking supply, and these may have any sort of sanitary character whatever. For that reason it is as much a matter of sanitary importance to furnish water of good appearance, such as a mechanical filter can produce with a highly colored water, or a sand filter with a fairly clear water, as to reduce the number of bacteria contained in the water.

We very soon will have an example of the two types of filters operating with one water at Montreal, where, I understand, mechanical filters will be used for a part of the supply, while the rest of the city will probably be supplied through sand filters, operating at a 10 000 000-gallon rate.

Dr. Swarts. I have nothing particular to say in closing the discussion, except to state that I am very much pleased to hear Dr. Clark state that there may be other influences than filtration which will cause a decrease of mortality sometimes.

If we depended upon statistics entirely, for information with regard to the advantages of a filter, we should hardly want to hark back to conditions at Washington, where an ideal sand-filter plant has been installed and pure water secured, and immediately the typhoid death rate rises. Not one of us would assume that the plant was at fault, that it wasn't a perfect filter, and yet the typhoid fever rate goes up. There are other influences, and those influences are not all discoverable, for by a thorough examination made of 5 000 cases of typhoid within a certain time in the District of Columbia, through the Marine Hospital Service and that of the local district authorities, it was found that one could ascertain the cause of typhoid fever in only about 65 per cent. of the cases; and of that number those who partook of filtered water made up only about 15 to 20 per cent. Where the largest amount occurred was where water was used which was taken from other sources. So I think statistics are a little deceiving, and ought not to be quoted against any sand or mechanical filter plant.

MR. CLARK. I agree entirely with what Dr. Swarts says so far as it goes. We can pick out special instances in almost any matter to illustrate the other side, but I am talking about average results from average good sand filters and average good mechanical filters.

MR. ROBERT E. MILLIGAN.* Mr. President, it has been a real pleasure to me to hear the apologies for slow-sand filtration. In the last twenty-five years I have had occasion to examine and to hear results from both sides. While it is unfortunate, in one sense, that I might be considered as predisposed toward mechanical filtration unduly, I hope the Association will quite believe me when I say that my sympathies are with the branch of water purification that I have been identified with so many years. Mr. Clark has, of course, made certain statements which I think any one can recognize as opposed to mechanical filtration, and identifies two particular plants as being notable failures in that respect. Speaking from memory in answer to this (while I am sure he is sincere in desiring information), I think the case of Elmira is an exceedingly poor citation in this connection. Possibly no city in the United States has been so carefully combed for

* Manager New York Continental Jewell Filtration Company.

sanitary results as that same city of Elmira, and, so far as I could ever see, chiefly because they were unfortunate enough, some fifteen or sixteen years ago, to put in a mechanical filter plant in opposition to the slow-sand method. In the Washington investigation, Elmira was used as a horrible example — and perhaps the most horrible example at that time — that was forthcoming against mechanical filtration. Notwithstanding the fact that mechanical filters had been introduced there and had been in operation, I believe, about two years, there wasn't any noticeable decrease in deaths from typhoid fever. The explanations of the superintendent and the local board of health as to this were apparently not satisfactory to the commission who were interested in recommending slow-sand filters for the city of Washington. These gentlemen of Elmira having some idea that, being United States citizens with very strong backbones, it was possibly up to them to put in shape the reason why the city of Elmira had failed to disclose the reduction in typhoid fever that anybody with a sane and normal mind would expect would follow the introduction of mechanical filtration, the situation was investigated, and it can easily be proved to Mr. Clark, or to the Massachusetts State Board of Health, that the cases in Elmira which showed the high death rate from typhoid fever were almost wholly due to wells and other causes among the water-takers who did not use the supply that the water company of the city of Elmira furnished from mechanical filters.

The city of Elmira was supplied by water from a water company, which, of course, is against them on the face of it. These gentlemen naturally could not supply any more takers than were quite willing to take the water from the water company. No coercion, of course, was possible, and each man who had a well in his back yard, and each milkman who washed his cans from a well in his back yard, had a grievance, and a *prima-facie* case, in opposition to the water company who were furnishing a bright, clear, and, as the water company contended and the analysis showed, sanitarily pure water. I do not believe any one who will take the results from the city of Elmira the last ten years, take the analyses — and they have been compiled without any leaning or bias towards the process of mechanical filtration — could doubt for a single

minute that they have enjoyed one of the most potable and pure supplies in the United States. These are statistics, and it certainly is a great pleasure to me to call Mr. Clark's attention to them and I would be very glad indeed to furnish the data at any time proving these simple facts.

There was another point raised by Dr. Swarts that I should like to speak of, getting back to mechanical filtration, and that is, the devices that are peculiar to it. I want to say right here that it isn't very difficult to differentiate between the two processes of filtration, notwithstanding Mr. Weston's very clever assimilation of these radically different processes. The fact remains that mechanical filtration depends very largely on the use of a coagulant, of a chemical, — any word, no matter how harsh, — to coagulate the water before it goes to the sand beds. In the system which Mr. Weston has called to your attention, they have raised the rate to 10 000 000 gal. per acre as against 2.6; but you must not lose sight of the fact that Wilmington in raising the rate of slow-sand beds has not forgotten to first purify the water through a mechanical filter, using a coagulant. I am not calling attention to this in any sense of criticism. Notwithstanding the fact that the process known as slow-sand filtration came from Europe, does it really follow that the American idea of coagulating water,— and it is purely an American idea so far as mechanical filtration as a means of purifying water supplies is concerned, — because it is an American idea, should receive the opprobrium and the censure not only of the great body of engineers but of the state board of health as well? It may be that the two things are coming closer together; but, if they are, it must be evident to any one who has ever been associated with the purification of water that mechanical filtration is not stepping in that direction as fast, nearly as fast, as slow-sand filtration is coming towards the process that you all know as mechanical filtration.

In regard to the air-wash and the agitator, there is a great division of opinion to-day, and there probably always will be, as to whether a mechanical filter can be washed as well by air as it can by an agitator. I suppose, if I belong to any school, I might be termed an air-washing filtration man; and yet I am not satisfied in my own mind that we have got very much beyond

the value of a rake or an agitator in washing sand. I suppose, and I guess Mr. Weston will bear me out, that there has only been one real test that would satisfy everybody made in this country as to the comparative value of an air-washing filter and an agitator filter under exact conditions with the same capacities; if I am not mistaken, that was under the direct observation of Mr. Weston himself at New Orleans. And if my recollection serves me further, the result there was that the effect of washing a sand bed with air as opposed to washing with the agitator was sufficiently similar that, all other conditions being the same, there wasn't any reason why one or the other process should not be used. That is as near as my memory of the particular case goes, and I think Mr. Weston will bear me out.

So far as the case both Dr. Swarts and Mr. Gilbert Pratt referred to, of the fluffing of the sand bed, which occurred at Bristol-Warren, R. I., my own estimate of that condition was that it was due not in any sense to the method of washing. The Bristol-Warren supply is probably as difficult a supply to handle as exists within my knowledge of purification to-day. The color has gone as high as 180, which is about the color of strong coffee. In addition to that, if there is any form of algæ which does not exist there, it is simply because no one has ever taken the trouble to catalogue it; it was there, I am satisfied. Now, we all know that in the last two or three years most of the ponds and impounded reservoirs in the country, and the sections of the country which depend on them, have been subjected to considerable drought, and all the conditions which turn the hair of the filtration man white have been present to a tremendous extent — and Bristol-Warren wasn't any exception to that condition.

My idea is that the algæ condition at Bristol-Warren produced a raw water carrying to the filters a large quantity of soluble and suspended organic matter, mostly soluble, for there is very little suspended organic matter in the water, as I remember it, and this organic matter was drawn into the bed beyond what might be called the filtering zone, that is, the eight or ten inches from the surface, into the body of the bed, where it became a source of secondary pollution; and no matter what percentage of the amount may have been removed by the superimposed layer

of coagulum, the partially purified water coming into contact with this mass of rich organic soluble material again received its quota of food, and the bacteria increased to an extent which was almost inconceivable. There is nothing really new about it. The old Warren mechanical filter, for example, with its dark, clear water basin underneath, sometimes developed that trouble, and we could tap almost any part of the filter bed above the strainer system and get 90 to 99 per cent. reduction of bacteria; and yet in the under channels there was found increase at times due to inefficient methods of washing or perhaps construction. Now, whether or not in the case of Bristol-Warren an agitator as opposed to the air-wash would have removed the difficulty, there is no way of knowing. Apparently not. As I say, the only real knowledge we have as to the relative merit of the two methods is from those experiments at New Orleans where an air-washing filter and an agitator filter side by side operated under exactly the same conditions.

REPORT OF THE COMMITTEE APPOINTED TO INVESTIGATE THE CONDITIONS UNDER WHICH EXTENSIONS OF MAIN WATER PIPES ARE MADE.

[*Presented January 11, 1911.*]

To the New England Water Works Association, — Your committee appointed to investigate the conditions under which extensions of main water pipes are made in municipally owned water works, particularly with reference to the requirement of a guaranty, respectfully report as follows:

A blank form, copy of which is reproduced in Appendix A, was prepared and sent to all the municipally owned water works in New England as far as we had record of them; also to our members who have charge of similar works in other parts of the country. Through oversight, a number of these forms were also sent to members who are managing private water companies, and a few of these have replied with statistics which are outlined below, although these are without the field of the inquiry as planned.

One hundred and forty-one replies from municipal works were received. The principal data contained in these replies are presented in Table 1, below, which shows the municipalities which do and which do not require a guaranty, and the terms of such guaranties as far as they can be stated in a few words.

It should be noted that, practically without exception, these guaranties are required only when there is doubt about getting sufficient income, in the form of water rates, from an extension of the pipes.

Analyzing the returns in a rough way, it is seen that 73 places, or 52 per cent. of those reporting, require a guaranty, and 68 places, or 48 per cent., do not. In this classification, works reporting that guaranties are " usually " or " sometimes " required are included among those giving a positive answer, while those which " rarely " require guaranties are included in the negative column. In a general way, therefore, it may be said that about

one half of the municipal water works require guaranties before extending water pipes in regions where the returns are doubtful, and the other half do not.

An examination of the table indicates further that the practice of requiring guaranties is more common in small towns than in the larger cities, although this rule is by no means invariable, since Boston requires a guaranty in the form of a cash deposit, equal to 25 per cent. of the estimated cost of the pipe line (or, in other words, the equivalent of 5 per cent. income for five years).

With regard to the amount of the guaranty, the practice is not by any means uniform; indeed, the percentage of cost which is considered a fair return varies very widely, as shown by the following statement:

10	places	require	a	guaranty	of	4	per cent.
17	"	"	"	"	"	5	"
19	"	"	"	"	"	6	"
4	"	"	"	"	"	7	"
8*	"	"	"	"	"	8	"
13	"	"	"	"	"	10	"
1	"	"	"	"	"	12½	"

The average percentage for these 72 places being 7.6 per cent.

It is worthy of note that in the state of New York guaranties are not necessary as, in accordance with the state law, undeveloped property is assessed water rates upon a definite basis per foot of frontage, and these rates are collectable in the same way as taxes and are a lien upon the property. In this way lots which are not built upon assist in bearing the cost of water pipe extensions and in maintaining the works. In the case of Albany the amount so assessed on vacant lots is 10 cents per year per front foot. Lumber yards are similarly assessed 20 cents per front foot, and buildings to which water is not supplied are assessed upon a specified scale.

The *form of guaranty* required from parties interested in securing extensions of the pipes varies considerably. We give in Appendix B copies of the best forms of such guaranties which were submitted to us. With these as a guide, any superintendent should be able to prepare a suitable form which will fit his own conditions.

* Including one place where the percentage varies from 6 to 10.

With regard to success in collecting guaranties, experience varies widely. Some places report very poor success, others no trouble whatever. It would seem to be the best practice to require a bond with suitable surety, as is the custom in a number of places. An examination of the forms of guaranty will indicate that some of these are in themselves bonds.

Another question which has not received by any means a uniform solution in different places is that of the permanency of the guaranty. Many places apparently put no time limit to the guaranty and presumably expect to collect it until the income, in the form of water rates, reaches or exceeds the amount guaranteed. Other cases require a stipulated percentage for a definite term of years, — for instance, 5 per cent. per annum for five years.

In nearly every case all sums received as water rates from takers upon the line of pipe are credited against the guaranty, but in a few cases the percentage guaranteed is required in addition to whatever water rates may be received.

In addition to the statistics of municipal works, replies from 13 water companies were received, containing more or less information. Eight of these 13 require a guaranty. In 6 cases the guaranty is 10 per cent., in one case 15 per cent., and in one case $7.00 per 100 feet of 6-inch pipe and $9.00 per 100 feet of 8-inch pipe.

The original answers which we have received have been bound in book form and deposited in the Association's library, where they are accessible for further reference at any time.

Respectfully submitted,

CHARLES W. SHERMAN,
EDWIN C. BROOKS,
A. W. F. BROWN,
GEORGE H. ROBERTSON,
NORMAN A. McMILLEN,
Committee.

APPENDIX A.

[FORM OF CIRCULAR.]

CONDITIONS OF MAKING EXTENSIONS OF MAIN WATER PIPES.

NEW ENGLAND WATER WORKS ASSOCIATION.

BOSTON, January 25, 1910.

The undersigned have been appointed as a committee to investigate and report upon conditions under which extensions of main pipes are made by municipally owned water works.

The following data are desired by the committee, and members of the Association and others who can contribute such information are requested to fill out the blanks and return this form as soon as possible to Charles W. Sherman, 14 Beacon Street, Boston, Mass.

CHARLES W. SHERMAN, *Chairman*,
EDWIN C. BROOKS,
A. W. F. BROWN,
GEORGE H. ROBERTSON,
NORMAN A. MCMILLEN,
Committee.

1. *Place.*
2. *Control of Water Works vested in :*
   (*a*) Water board of members.
   (*b*) Single Water Commissioner.
   (*c*) Committee of City Government.
   (*d*) Other Officer or Board (state what).
3. *What authority decides when extensions of main pipes shall be made?*
   (*a*) Water board or commissioner.
   (*b*) Town meeting or city council.
4. *Is a guaranty from prospective water takers required before an extension is ordered?*
5. *Give particulars relating to guaranty when required.*
   (*a*) Percentage of actual cost.
   (*b*) Percentage of estimated cost.
   (*c*) Percentage of estimated cost of a 6-inch pipe.
   (*d*) Guaranteed revenue per 100 feet of extension.
   (*e*) Other form of guaranty.
6. *In case a guaranty is required, is the amount in any way dependent upon or affected by the following factors:*
   (*a*) Improvement in fire protection to be obtained by proposed extension.
   (*b*) Improvement in circulation.
   (*c*) Other factors.

7. *In computing actual or estimated cost of extension upon which percentage guaranty is based, what items are included?*
   (*a*) Cost of labor and materials only.
   (*b*) Cost of inspection.
   (*c*) Cost of holidays, vacations, or other absences with pay allowed to persons engaged upon this work.
   (*d*) A proportionate cost of office and other standby expenses.
8. *If a guaranty is required under a city or town by-law, quote by-law.*
9. *Quote form of guaranty required.*
10. *What has been your experience in collecting such guaranties?*

Dated 1910. Report by

APPENDIX B.

FORMS OF GUARANTY OF REVENUE REQUIRED BEFORE MAKING EXTENSIONS OF WATER PIPES.

1. BEVERLY, MASS.

Know all men by these presents, that we, the undersigned, owners of land, or land and houses, fronting and abutting upon Street in Beverly, in the Commonwealth of Massachusetts, do hereby severally agree and further bind ourselves, our heirs, executors, administrators and assigns,

In consideration of the laying of a water pipe or pipes, to wit, about feet in length, be the same more or less, in said Street, by the city of Beverly, a municipality duly incorporated by the Commonwealth of Massachusetts, by and through the Water Board of said city, for the use of said pipes, or for the consideration aforesaid, such sum or sums, payable by such annual installments, to be apportioned by said board, as shall equal in the aggregate the amount of at least four (4) per cent. of the entire cost to the city of said laying, said apportionment to be made according to ;

and said installments shall continue to be paid by us in the manner above mentioned, until said amount of four (4) per cent. shall have been fully paid, or until said board in its discretion shall become satisfied from whatever cause to establish an annual regular fixture-rate, in which event said four (4) per cent. basis shall be substituted by such fixture-rate, under the law and rules of said board duly made and provided.

2. BOSTON, MASS.

$.....

Received of the sum of dollars, being the difference to make up per cent. for five years on the cost of laying water pipes in Street, as per petition on file dated ; said amount being received on deposit for five years unless sooner cancelled by income from water rates. Any additional income derived on the line of pipe laid under said petition within five years from date will be refunded at the expiration of that period, but should there be none, then the whole amount will be forfeited to the city.

Preserve this receipt. _____

3. BRIDGETON, N. J. _____

To the City Council of the City of Bridgeton, — We, the undersigned, hereby make application for the laying of a main pipe in Street, of a suitable size for all future applicants that may apply on said street, or extension, and all other contingencies that may appear to the committee, a distance of inch pipe; and

We do hereby agree that if said pipe should be laid, we will forthwith make

application for the laying of service pipe to our respective premises according to the form adopted by City Council, and will pay the amount set opposite our names, annually, so that the total amount will pay 6 per cent. per annum on the amount invested by the city of Bridgeton. If these amounts are in excess of the actual rates, then we, the first to pledge the amount, shall be released proportionately for all amounts paid over and above the actual rates; and,

We do further agree that said water rates shall commence in ten days after main pipe is laid, and that our property shall be held responsible for the amount according to law.

Name.	No.	Street.	Amount.

4. BROOKLINE, MASS.

BROOKLINE, MASS., 191

The undersigned, owners of real estate on the way or street known as , desiring to have water pipes laid in said way, hereby severally release all claims to damages in consequence of laying said pipes and maintaining the same.

We also hereby agree to guarantee an income of at least five per centum per annum upon the cost of laying said pipe for five years, provided the revenue of water takers from the same shall not equal that amount.

5. DOVER, N. H.

To the Board of Water Commissioners of the City of Dover,—The undersigned, owners and occupants of real estate situated upon in the city of Dover, N. H., hereby petition your board to cause a main water pipe to be laid through said from Street to Street; and in consideration of the laying of said pipes in the above-named by the said city of Dover, as herein prayed for, we agree for ourselves, our heirs and assigns, to take water from said pipes under the current rules and regulations made by said Board of Water Commissioners, and pay to said city of Dover at the office of said Board of Water Commissioners, on the first day of each quarter, an income equal to 5 per cent. per annum upon the cost of laying said pipe in addition to the regular rates for water established by said Board of Water Commissioners.

This agreement shall remain in force until the income from the sales of water from said pipe shall equal the cost thereof, when said Water Commissioners shall cancel said agreement, and thereafter said other parties hereto shall be assessed therefor only by the regular rates established for the sale of water.

6. HAVERHILL, MASS.

AGREEMENT.

HAVERHILL, 191

the subscriber, being desirous that the water pipes of the

city of Haverhill be extended from said pipes on Street, thence

do hereby guarantee to the Board of Water Commissioners of the city of Haverhill, in case they so extend said pipes, that the income from the water rates, for the water supplied through said extension, at the usual charges made therefor, as established by said Board of Water Commissioners, shall be equal to 5 per cent. on the cost of so extending said pipes, and making the needed connections.

This guarantee and obligation to continue in force for a period of five years from the time of laying said pipes, and in case the water subscribed and paid for between the above-named limits from said proposed extended pipes shall not amount to a sum equal to or more than said interest, then , the subscriber , do jointly and severally hereby agree to pay annually to the Board of Water Commissioners of the city of Haverhill such a sum of money as said aggregate water rates shall fall short of said interest on said cost.

7. Lancaster, Mass.

Lancaster Water Department.

CONTRACT FOR SERVICE EXTENSION.

In consideration of the extension of water service by the Water Department of the town of Lancaster
from to .

We hereby promise and agree for ourselves and our heirs, administrators and assigns to pay to the town of Lancaster (Water Department) during each and every year of the ten years next ensuing, a sum equal to eight (8) per cent. of the total expense of such extension.

Witness our hand and seal this day of

8. Leominster, Mass.

To the Leominster Water Board, — The undersigned request you to lay a main pipe in Street or Avenue direction, distance, size of pipe, etc., and we jointly and severally agree to and with the town of Leominster that if said pipe is laid with proper appendages, that water enough shall be taken from said pipe to the premises on the line thereof to make the regular rates therefor (exclusive of the rates for all water taken by said town for hydrants, watering troughs, sprinkling streets, public buildings and all other purposes) amount to 5 per cent. per annum on the cost of said pipe and appendages when laid.

And if such regular water rates (exclusive of the rates for all water taken by said town) do not annually amount to said percentage, we jointly and severally agree to pay to said town semi-annually, at the times when the semi-annual water rates are due, any deficiency.

In witness whereof we have hereto set our hands and common seal, each of us adopting the seal set against the first signature as our common seal, this day of 19 .

9. LYNN, MASS.

Know all men by these presents, that we, , owners of real estate on Street, so called, that, in consideration of the city of Lynn extending its water pipes to premises, hereby agree to pay a sum each year, which, in addition to the income received, shall equal five (5) per cent. of the cost of construction.

This contract or agreement to be null and void after a sufficient number of takers have been connected to said pipes to equal the required amount.

In witness hereto, set hand and seal this day of 191 .

10. MALDEN, MASS.

MALDEN, MASS., 191

To the Malden Water Board, — We, the undersigned, hereby make application for laying of a main pipe in about feet, and we jointly and separately agree that in case the water rates are insufficient to pay seven (7) per cent. on cost of laying said pipe, we will make up the deficiency.

11. MANCHESTER, N. H.

To the Honorable Board Water Commissioners of the City of Manchester, — The undersigned, owners and occupants of real estate situated upon Street in the city of Manchester, hereby petition your honorable body to cause the water pipes to be laid through street , and in consideration of the laying and extending of said pipes in the above-named street, by said city, as herein prayed for, hereby agree for

sel for heirs, administrators, executors and assigns, to take water from said pipes under the current rules and regulations made by the Water Commissioners, and pay to said city at the office of the Water Commissioners, on the first day of each quarter, an income equal to 4 per cent. per annum upon the cost of laying said pipe, in our several proportions, based upon the use made of water upon our respective estates; provided, also, that no individual party thereto be assessed less than five dollars per annum as his respective share.

This agreement shall remain in full force until the income from the sales of water from said pipe shall exceed the amount above stipulated, when the Water Commissioners shall cancel the agreement, and ever thereafter the party or parties to these presents shall be assessed therefor only by the regular rates established for the sale of water by the Water Commissioners.

Signatures of Owners of Property.

12. NATICK, MASS.

The Honorable Board of Water Commissioners of the Town of Natick, — We, the undersigned, owners and occupants of real estate situated upon

Street in town of Natick, hereby petition your Honorable Board to cause the water pipes to be laid through said street or streets, and in consideration of the laying and extending said pipes in the above-named street or streets by said Water Board, as herein asked for, we, the undersigned, hereby agree for ourselves, and for our heirs, administrators, executors and assigns, to take water from said pipes under the current rules and regulations made by the Water Board for the government of the water department, and to pay to said town, at the office of the superintendent, the amount set against our names as water rates, and we do further agree that we will continue to pay said rates semi-annually, till the said Water Board may see fit to abate, and we agree that we will pay the same rate whether we use the water or not, till the Water Board may release us.

Names.	Fixtures.	Amount.

13. NEW BEDFORD, MASS.

GUARANTEE.

Whereas, connecting the premises of the undersigned with the New Bedford Water Works system is not, in the judgment of the New Bedford Water Board, expedient at the present time, unless provision be made for the payment of a special rate; now, therefore, the undersigned hereby covenants and agrees with said city as follows, viz.:

In consideration of the laying of a water main pipe by the said city of New Bedford along the line of , the undersigned hereby jointly and severally agree and bind themselves to pay to the city of New Bedford, annually, in advance, on the first day of July, a sum equal in amount to 6 per cent. of the cost to the city of the above-described line of water main pipe and the laying of the same, and in addition it is hereby understood that upon failure on the part of the undersigned, or their assigns, or legal representatives, to comply with the terms of this agreement, the said city by its Water Board shall have the right to shut off the water from the service pipe on the premises of the undersigned, and, further, shall have the same control over the water, and the delivery of the same through the pipes, as it now has in respect to any other main pipe in the city.

It being understood, however, that this yearly payment is to be diminished yearly hereafter by whatever the city may receive from other takers, until the undersigned shall only be required to pay the usual water rates charged consumers throughout the city.

And upon the above-described terms only the city, by its Water Board, agrees to lay the above-described line of pipe.

Witness the hand and seal of the parties the day and year above written.

NEW BEDFORD, MASS., 191

We, the undersigned, owners of property abutting on hereby agree that in case water pipes are laid by the city of New Bedford in said said

city, and all persons acting in its behalf, shall be holden free from all claims for trespass, or damage, or otherwise, by reason of laying said pipe, and the authorized agents of said city shall be allowed by us free access to said and all necessary uses thereof, at any and all times, for the purposes of repairs, extension, inspection or otherwise, and to make all excavation thereof, and generally said city is to have all rights of uses respecting said incidental to water administration as if said was a public street; and it is further agreed that the city of New Bedford, by laying of the aforesaid water main, shall in no way become liable, or bound to accept, or keep in repair said

14. NEWTON, MASS.

Extensions of main pipe shall only be made when authorized by the Board of Aldermen. Applications therefor must be made upon the blanks furnished by the Water Commissioner, upon which shall be endorsed the estimate of the probable cost of the extension desired. No such application shall be considered by the Water Commissioner unless accompanied by a written agreement, binding the applicant or other responsible party to guarantee to the city annually, for at least five years, a sum equal to 5 per cent. of the total cost of the extension, but the applicant shall in no case be required to guarantee on a sum greater than the estimated cost of a 6-inch pipe. All receipts for water sold from such extension, and no other, shall be credited to the party making such guaranty as payments upon account of same.

Applications for extensions of mains through private ways or grounds shall in no case be granted unless the owner thereof executes a proper instrument securing to the city the right of permanent occupation, free from any acts of interference that shall affect the safety of the pipe, and securing to the department free right of entrance for purposes of inspection and maintenance. Nothing in this section, however, shall be construed as affecting the right of the Board of Aldermen to authorize the extension of a water main without guaranty if, upon a vote taken by yea and nay, two thirds of the members present and voting shall vote to do so.

CITY OF NEWTON. WATER DEPARTMENT.

GUARANTY FOR EXTENSION OF WATER MAIN.

Know all men by these presents, that, in consideration that the city of Newton shall lay a water main in Street, in Ward , of said city, to supply with water the premises of , the undersigned hereby covenants with and promises said city to pay to its city treasurer on demand, in advance, each year, for the term of years from the date hereof, the sum of dollars.

Said city of Newton, by accepting this instrument, agrees to repay to the undersigned at the end of each year of said term such sum, not exceeding the

amount paid to it under this agreement, as it shall receive during such year for water delivered by such main excepting any amount that it may receive for water delivered to said city of Newton.

The obligations of each water taker, however, for the payment of water rent under the provisions of the city ordinance, are not to be affected by this stipulation.

Witness hand and seal, at Newton, the day of A.D. .

Signed and sealed in the presence of

---

15. North Andover, Mass.

Vote of town at annual town meeting, March 9, 1907.

Article 16. *Voted*, to authorize the Water Commissioners to lay water pipes on unaccepted streets provided funds are available and the abutters give a release of right of way and guarantee a sum as water rates equal to 5 per cent. of the cost of construction.

Form of Guarantee.

Know all men by these presents, that we, , of , in the County of and Commonwealth of , as principal, and of and of , as sureties, are holden and stand firmly bound unto the town of North Andover, a municipal corporation in said county and commonwealth, in the sum of , to the payment of which to the said town of North Andover, or its successors or assigns, we hereby jointly and severally bind ourselves, our heirs, our executors, and administrators.

The condition of this obligation is such that, whereas the said principal has guaranteed, and does hereby guarantee, to the town of North Andover an income or return of not less than 5 per cent. per annum on the cost of a proposed extension of its system of water works by the laying of pipes in, over or through an unaccepted street or way known as in said North Andover, from main pipe on to a point feet on , for and during the time which said street or way shall remain unaccepted by the town and for a period of ten years thereafter; and to the end that said guarantee may be performed, has agreed, and does hereby agree, to pay or cause to be paid to the town such sums as together with actual receipts from water rates shall at all times covered by said guarantee equal 5 per cent. per annum on the said cost of construction, which said payments are to be made as and when required by the Board of Public Works of North Andover.

Now, therefore, if the town of North Andover shall construct said extension, and if the said obligors shall well and truly pay, or cause to be paid, to the town the sums secured by the above guarantee and agreement, when and as due, during the entire term covered by the same, then this obligation shall be void, otherwise it shall be and remain in full force and virtue.

In witness whereof, we hereunto set our hands and seals this day of in the year one thousand nine hundred and .

In presence of .

.....[SEAL.]
.....[SEAL.]
.....[SEAL.]

16. NORWOOD, MASS.

Know all men by these presents, that for the consideration that the town of Norwood shall lay a water main in Street from present terminus to to supply water to premises in which the undersigned are interested, hereby jointly and severally covenant, promise and agree to and with said town of Norwood to pay to the Water Commissioners thereof for and during the term of ten years from the date hereof, on demand, in advance, each year, the sum of , said town of Norwood by accepting this instrument agrees to repay to the undersigned each year of said term such sum, not exceeding the amount paid by the undersigned as aforesaid, as shall be received during that year for water supplied by said extension.

This instrument is not to affect, prejudice or impair any liability or duty whatsoever of any water-taker to pay water rates.

Witness our hand and seal this day of 19 .

Witness: Signature [SEAL]. Amount.

17. READING, MASS.

Know all men by these presents, that the undersigned, in consideration of one dollar and other considerations to them paid by the town of Reading, in the County of Middlesex and Commonwealth of Massachusetts, do hereby promise and agree jointly and severally that if the said town will lay a water pipe or water main through that portion of Street in said Reading, from to and connect said water pipe or main with the water supply of said Reading and supply water in the customary manner to the premises adjoining that part of the street through which said water pipe or water main may be laid,

We will and do hereby guarantee that said town shall receive on January 1, A.D. , the sum of $ as water rates from said premises taking water from said pipe or main, and a like sum on the first day of January in each and every year thereafter until such time as there shall be water-takers enough on said street, whose water rates, at the customary charge, would equal the sum of $. And for ourselves, our executors, and administrators, jointly and severally, do hereby promise and agree to pay to said town, on demand of the superintendent of the Reading Water Works and his successors, on the first day of January of each and every year as aforesaid, such sum of money as will equal the difference between the water rates collected by the town on January 1 of each year from the said premises and said sum of $.

Witness our hands and common seal this day of A.D.

[SEAL.]

We, the undersigned, as sureties, do hereby guarantee the performance of the within agreement.

In witness whereof we hereunto set our hands and seals this day of A.D.

18. SPRINGFIELD, MASS.

To the Board of Water Commissioners of the City of Springfield, — The undersigned residents and property owners on Street (so-called), respectfully petition for a main water pipe to be laid in said street as follows:

And in case this petition is granted, and in consideration thereof, we severally hereby covenant and agree with the city of Springfield that we will make immediate application for the laying of service pipes to our respective premises, and will thereupon become water-takers, all in accordance with the current rules and regulations of said board, and that *we will pay on demand the annual amounts set against our respective signatures* until the annual water rental derived from said main pipe shall equal the sum of said guaranteed amounts; provided, however, that all such annual water rental received from ourselves or other water-takers, as per the current tariff of rates of said Board, shall first be applied toward such guaranteed payments.

We furthermore severally bind ourselves, our heirs, executors and assigns, to pay, as aforesaid, and from date of letting water into said main pipe, the annual amounts set against our respective signatures, whether the water is used or not.

Witness to signatures. Signatures. Annual amounts guaranteed.

19. TAUNTON, MASS.

In consideration of the laying of water pipes by the city of Taunton along the line of Street in said Taunton so as to allow the supplying of the premises of the undersigned with water from the Taunton Water Works, the undersigned hereby agrees to take water from said Taunton Water Works at the rates now or hereafter to be established for all takers thereof to the extent of dollars per annum for the period of years, and hereby guarantees the payment of all said rates for the time aforesaid.

This agreement is to be in force and payment of the rates aforesaid to the extent above stated is to be made as well if the undersigned shall not by himself or his tenant introduce and use the water of the Taunton Water Works in and upon his premises as if he shall so do. Said rates to begin when the Water Commissioners of said Taunton shall in writing notify the undersigned that he can be supplied with water as aforesaid by connecting with said Water Works.

Witness my hand this day of A.D. 189 .
Sign here.
Witness:

20. WALTHAM, MASS.

Know all men by these presents, that in consideration that the city of Waltham shall lay a water main in Street, in said Waltham, to supply with water the premises of
the undersigned hereby covenant with and promise the city of Waltham to pay to the said city, on demand, in advance, each year for the ten years succeeding the date hereof, the sum of 5 per cent. on the cost of laying said main, upon the condition that such sums as said city shall annually receive for water delivered by such main not exceeding the amount of such annual advance shall at the end of each year be repaid by said city to the undersigned. The obligations of each water-taker, however, for the payment of water rent under the provisions of law in that behalf provided are not to be affected by this stipulation.

Witness hand and seal , at Waltham, the day of A.D. 189 .

Signed and sealed in the presence of

TABLE 1.

PRINCIPAL STATISTICS RELATING TO CONDITIONS PRELIMINARY TO EXTENDING MAIN WATER PIPES, FOR MUNICIPALLY OWNED WATER WORKS.

Place.	Decision Relating to Extensions Made by	Is Guaranty Required?	Particulars of Guaranty.	Other Information.
1. Albany, N. Y.	Supt. Water Works.	No.	Water rates are assessed as taxes, at a definite rate per front foot.	
2. Arlington, Mass.	Board Public Works.	Yes.	6% on estimated cost of 6-inch pipe, for 5 years.	Deposit required in advance by vote of town.
3. Atlantic City, N. J.	Water Board.	No.		
4. Auburn, Me.	Water Commissioners	No.		
5. Baltimore, Md.	Water Board.	No.		
6. Bangor, Me.	Water Board.	Yes.	10% of estimated cost.	
7. Bedford, Mass.	Town meeting, on recommendation of Water Commissioners.	Yes.	5% for 5 years, on cost of 6-inch pipe.	
8. Belmont, Mass.	Water Commissioners	Yes.	6% of estimated cost.	
9. Bethel, Conn.	Water Board.	No.		Extensions not usually made unless Board is confident of 5% return.
10. Beverly, Mass.	Water Board.	Yes.	4% of cost.	
11. Billerica, Mass.	Water Commissioners or town meeting.	No.		
12. Boston, Mass.	Water Commissioner.	Yes.	25% of estimated cost of 6-inch pipe (equivalent to 5% for 5 years).	Whole amount deposited in advance.
13. Bridgeton, N. J.	City Council (seven members).	Yes.	6% on cost.	Extensions not made unless they will return 6%.
14. Brockton, Mass.	Water Board.	Seldom.		
15. Brookline, Mass.	Water Board.	Yes.	5% on cost of 6-inch pipe.	Bond often required.
16. Burlington, Vt.	Water Commissioners or City Council.	No.		Extension not usually recommended unless they will return 6%.
17. Cambridge, Mass.	Water Board.	No.		
18. Chelsea, Mass.	Water Board.	No.		
19. Chicopee, Mass.	Water Board.	No.		
20. Claremont, N. H.	Water Commissioners	Yes.	8% of cost.	
21. Columbus, Ohio	Director Public Serv.	No.		
22. Concord, Mass.	Water and Sewer Commissioners.	Yes.	4% for 10 years.	

23. Concord, N. H.	Water Board.	Sometimes.	4% or 5% of estimated cost	
24. Danvers, Mass.	Town meeting.	No.		Usually do not make extensions which will not earn 5%.
25. Denison, Tex.	Commissioners.	No.		Extensions not made unless revenue equals or exceeds 10% on cost of 6-inch pipe.
26. Dover, N. H.	Water Board.	Yes.	5% on cost, in addition to regular water rates, until returns from water rates have equaled cost.	
27. East Orange, N. J.	Water Board.	Yes.	10% of cost of 6-inch pipe.	
28. Enosburg Falls, Vt.	Water and Light Commissioners.	No.		
29. Everett, Mass.	Board Public Works.	Yes.	6% of estimated cost (first year only).	
30. Fall River, Mass.	Water Board.	No.		
31. Fitchburg, Mass.	City Council.	Yes.	6% of estimated cost.	
32. Foxboro, Mass. (Water Dist.)	District meeting.	No.		
33. Framingham, Mass.	Water Board.	Yes.	8% on estimated cost of 6-inch pipe.	
34. Franklin, Mass.	Water Board.	Usually.	10% on estimated cost.	
35. Franklin, N. H.	Water Commissioners	Sometimes.	5% on cost.	
36. Gardiner, Me.	Water Board.	No.		Extensions usually made when canvass shows gross income of 20% of cost.
37. Gloversville, N. Y.	Water Board.	Yes.	10% on cost.	
38. Grand Rapids, Mich.	Water Board.	Sometimes.	7% on cost.	
39. Great Barrington, Mass.	Water Commissioners	No.		
40. Greenfield, Mass.	Water Board.	Yes.	5% of cost in addition to water rates.	Guaranty required only where extension would evidently be unprofitable.
41. Hancock, N. H.	Town meeting.	No.		
42. Harrisburg, Pa.	Water Board.	No.		
43. Hartford, Conn.	Water Board.	Yes.	10% of actual cost.	
44. Hatfield, Mass.	Town meeting.	No.		
45. Haverhill, Mass.	Water Board.	Yes.	5% for 5 years.	
46. Hillsboro, N. H.	Water Commissioners	Yes.	Varies with the conditions, 6% to 10% of cost.	

TABLE 1. — *Continued.*

PRINCIPAL STATISTICS RELATING TO CONDITIONS PRELIMINARY TO EXTENDING MAIN WATER PIPES, FOR MUNICIPALLY OWNED WATER WORKS.

Place.	Decision Relating to Extensions Made by	Is Guaranty Required?	Particulars of Guaranty.	Other Information.
47. Hinsdale, Mass.	District meeting.	No.		
48. Holbrook, Mass.	Town meeting.	No.		
49. Holyoke, Mass.	Water Commissioners	No.		
50. Ilion, N. Y.	Water Board.	No.		
51. Jacksonville, Fla.	Board Bond Trustees.	No.		
52. Lancaster, Mass.	Water Commissioners	Yes.	8% for 10 years on total cost of extension.	
53. Lawrence, Mass.	Water Board.	No.		
54. Leominster, Mass.	Water Board.	Yes.	5% on estimated cost of 6-inch pipe.	
55. Lexington, Mass.	Water Board.	Yes.	7% of cost.	
56. Lincoln, Mass.	Town meeting.	Yes.	4% of cost, for 5 years.	
57. Louisville, Ky.	Bd. of Water Works.	Yes.	Generally 10%.	
58. Lowell, Mass.	Water Board.	Yes.	6% of cost.	
59. Lynn, Mass.	City Council.	Yes.	5% of total cost.	
60. Malden, Mass.	Street and Water Commissioners.	Yes.	7% of actual cost.	
61. Manchester, N. H.	Water Board.	Yes.	4% of cost.	
62. Mansfield, Mass.	Water Commissioners	No.		Extensions made only when revenue will amount to 6%.
63. Marblehead, Mass.	Town meeting.	No.		
64. Marlborough, Mass.	Water Board.	Yes.	5% of estimated cost of 6-inch pipe.	
65. Maynard, Mass.	Water Board.	Yes.	5% for 5 years.	
66. Middletown, Conn.	Water Board.	Yes.	10% on estimated cost.	
67. Millers Falls, Mass.	District meeting.	No.		
68. Milton, Mass.	Water Board.	No.		
69. Monson, Mass.	Water Board.	Yes.	4% of cost.	
70. Muscatine, Ia.	Water-Works Trustees	Yes.	6% of cost.	
71. Natick, Mass.	Water Commissioners	Yes.	Agreement to pay water rates whether water is used or not, until released by board.	
72. Needham, Mass.	Water Commissioners	Yes.	6% of cost.	Extensions are sometimes ordered by town meeting, without guaranty.

73. Newark, N. J.	Street and Water Commissioners.	Yes.	10% of cost of 6-inch pipe for 5 years.	
74. New Bedford, Mass.	Water Board.	Yes.	6% of cost.	
75. New Britain, Conn.	Common Council.	Yes.	8%.	
76. New London, Conn.	Water and Sewer Commissioners.	Yes.	5% on estimated cost of 6-inch pipe.	
77. Newmarket, N. H.	Town meeting.	No.		
78. New Orleans, La.	Sewerage and Water Board.	Yes.	8% of estimated cost.	
79. Newport, N. H.	Usually town meeting	Sometimes.	10% on estimated cost.	Water Commissioners have authority to extend pipes without vote of town when 10% guaranty is obtained.
80. Newton, Mass.	Water Commissioner.	Yes.	5% for 5 years on cost of 6-inch pipe.	
81. New York, N. Y.	Commissioner of Water Supply.	No.		
82. North Adams, Mass.	City Council.	No.		
83. Northampton, Mass.	Water Board.	Yes.	7% of actual cost.	
84. North Andover, Mass.	Board Public Works.	Yes, in case of unaccepted streets.	5% of estimated cost of 6-inch pipe, or 5% of whole cost of smaller pipe.	
85. North Chelmsford, Mass.	District meeting.	No.		
86. North Troy, Vt.	Water Commissioners	No.		
87. Norwalk, Conn.	City Council.	No.		
88. Norwich, Conn.	Water Commissioners	No.		
89. Norwood, Mass.	Town meeting.	Yes.	Definite sums annually for 10 years.	Water rates are credited but not in excess of sums guaranteed.
90. Oberlin, Ohio.	Water Board.	No.		
91. Ogdensburg, N. Y.	Water Board.	No.		
92. Peabody, Mass.	Water Board.	Sometimes.	4% on cost, secured by bond.	
93. Peterboro, N. H.	Town meeting.	No.		
94. Pittsfield, Mass.	Board Public Works.	Yes.	6% on actual cost, secured by bond.	
95. Pittsfield, Me.	Water Board.	No.		Usually want to realize 10% on cost.

TABLE 1.—*Concluded.*

PRINCIPAL STATISTICS RELATING TO CONDITIONS PRELIMINARY TO EXTENDING MAIN WATER PIPES, FOR MUNICIPALLY OWNED WATER WORKS.

Place.	Decision Relating to Extensions Made by	Is Guaranty Required?	Particulars of Guaranty.	Other Information.
96. Plymouth, Mass.	Town meeting.	Yes.	4% of actual cost for 10 years.	Bond required.
97. Portland, Me.	Water Board.	In rare cases.	10% of actual cost.	
98. Portland, Ore.	Water Board.	No.		
99. Poughkeepsie, N. Y.	Board Public Works.	Yes, for extensions outside city.	Total cost to be advanced by petitioners, and returned when there is one customer to each 75 feet of main.	
100. Poultney, Vt.	Village meeting.	No.		
101. Providence, R. I.	Commissioner Public Works.	No.	Applicants must pay entire cost if estimated income is less than 7%.	
102. Quincy, Mass.	Commissioner Public Works.	Yes.	Verbal agreement to pay 6% on cost 6-inch pipe.	
103. Randolph, Mass.	Town meeting.	No.		
104. Randolph, Vt.	Water Board.	No.		
105. Raymond, N. H.	Water Commissioners	In special cases.	6% of cost.	
106. Reading, Mass.	Water Commissioners	Yes.	4% of cost.	
107. Reading, Pa.	City Council.	No.		
108. Readsboro, Vt.	Village meeting.	No.		
109. Rochester, N. Y.	Commissioner Public Works.	No.		
110. Rockport, Mass.	Town meeting.	No.		
111. Saginaw, Mich.	Water Board.	Yes.	8% of cost.	
112. St. Johns, N. B.	Committee City Government.	No.		
113. Sharon, Mass.	Water Board and town meeting.	Yes.	6% of cost for 5 years.	
114. Somerville, Mass.	Water Commissioner.	No.		
115. South Norwalk, Conn.	Water Board.	Only if without city limits.	12½% of cost, except office charges.	
116. Springfield, Mass.	Water Board.	Yes.	10% of estimated cost of 6-inch pipe.	

117. Stoneham, Mass.	Town meeting.	Yes.	8% of actual cost.	
118. Swampscott, Mass.	Water Commissioners	Sometimes.	6% of cost.	
119. Taunton, Mass.	Water Board.	Usually.	6% for 5 years on approximate cost of 6-inch pipe.	
120. Tisbury, Mass.	Water Board.	Yes.		
121. Troy, N. Y.	Commissioner Public Works.	No.		Property taxable for water rates.
122. Uxbridge, Mass.	Town meeting.	Yes.	4% of cost.	
123. Wallingford, Conn.	Water Commissioners	No.		
124. Walpole, Mass.	Town meeting.	Yes.	6% for 10 years.	
125. Waltham, Mass.	Water Commissioner.	Yes.	5% on cost for 10 years.	
126. Ware, Mass.	Water Commissioners	Yes.	5% of cost for 5 years.	
127. Watertown, Mass.	Water Commissioners	Yes.	10% of estimated cost.	
128. Westfield, Mass.	Water Board.	Usually.	6% of estimated cost.	Bond required.
129. Westboro, Mass.	Water Commissioners	Yes.	5% of estimated cost.	
130. Whitman, Mass.	Water Board.	No.		It is not intended to make extensions unless the earnings will pay interest on the cost.
131. Williamsburg, Mass.	Town meeting.	No.		Extensions made only when they will return 15% income.
132. Wilmington, Del.	Water Board.	Only in special cases.		For real estate "booms," etc., 5% of estimated cost; secured by bond.
133. Wilton, N. H.	Town meeting.	No.		
134. Winchester, Mass.	Town meeting.	No.		When extensions are made, assessors usually increase assessed valuation.
135. Woburn, Mass.	Board Public Works.	Sometimes.	5%.	
136. Worcester, Mass.	City Council.	No.		
137. Wrentham, Mass.	Town meeting.	Yes.	6% of cost first year.	
138. Westerly, R. I.	Water Board.	Yes.	10% of actual cost.	
139. Woonsocket, R. I.	Water Commissioners	Yes.	6% of actual cost.	
140. Yarmouth, N. S.	Town Council.	No.		
141. Yonkers, N. Y.	City Council.	No.		

THE REFORESTATION OF WATERSHEDS FOR DOMESTIC SUPPLIES.

BY F. W. RANE, STATE FORESTER OF MASSACHUSETTS.

[*Read March 8, 1911.*]

Mr. President and Gentlemen of the New England Water Works Association, — The subject of municipal forests is more or less of a new idea, but I can see where forestry and water works are naturally coming together more and more. Most of you gentlemen I take it are engineers. Now, how can forestry come in along with your lines of work? I think the subject is likely to be of more and more importance as time goes on, to water-works people. I take it for granted that a great many of the works represented here are municipal works. Some of them may be private corporations, but they are all run upon practically the same lines. A few years ago, in 1908, I think it was, we had occasion in the State Forestry office to work out a plan for the city of Fall River, covering about 3 000 acres. At that time the Mayor and the commissioners and the engineer had an idea that they were going to carry the plan into effect, but for some reason or other it unfortunately has not been carried out to the extent that they had hoped it would be. They are doing something, however. They have an area of about 3 000 acres surrounding their water supply, and if any of you are interested in the report we made, I have extra copies at the office and would be glad to send them to you upon application.

At that time I read a paper before one of our scientific societies, the subject of which was "Municipal, Corporation and Private Ownership Forests," and, with your permission, I will read you a few paragraphs from that paper, bearing particularly upon the subject of municipal forests.

"The time is ripe for the development of this type of forestry. I believe all that is required at present is to agitate the subject and to explain how easily and economically it can be brought about. Our cities and towns have sprung up by the hundreds and

thousands throughout the land. Their development has been proportionate to their natural advantages. Permanency has become more stable as time has gone on until to-day finds us with municipalities ready and willing to accept and adopt almost any measure that will develop a better future and a busier center of population. Our cities and towns have been solving the problems of a permanent and efficient water supply, sewerage system, etc. Our boards of health tell us that a pure water supply is absolutely necessary to longevity of our population. Municipal forests about the drainage basins of our water supplies and reservoirs can be made not only an important factor in conserving the water supply and in improving sanitary conditions, but if put under a modern system of forestry management could be made a great economic factor in the production of wood and lumber. They may also comprise one of the great æsthetic features of the section. The time element as a factor so objectionable to the private owner in investing in forestry undertakings need not be considered here. The advent of the automobile and rapid transit has so enlarged the conceptions of the average citizen that instead of being content with shade trees and park systems, he longs for the depth and quiet of large tracts of woods, which may be furnished almost without cost through the wise forethought of our municipalities. Who has visited Germany without being impressed with the trip into the Black Forest? These very forests are not only beautiful and renowned but through their scientific treatment yield splendid net financial returns. Within walking distance from many of the cities, one can step into finer woods than can be found in our best Eastern states. Spruce and fir trees two to three feet through and all the way up to one hundred and twenty-five feet high stand on the ground as thickly as they can stand. There are acres that would cut more than one hundred thousand feet board measure.

"Municipal forests, therefore, will do much as object lessons, and their permanency and importance will assist very materially in forming a workable local, state, and national policy.

"The State Forester in Massachusetts has completed a working plan for the city of Fall River this season for a municipal forest of three thousand acres. We are working on similar projects for

three more cities at present, with still others on the waiting list. The Metropolitan Water and Sewerage Board of Boston have completed planting eleven hundred acres to forest trees about their new reservoir this fall. The city of Helena, Mont., has planted a forest of nine hundred acres. Warren Manning, the noted landscape gardener, the designer of the Jamestown Exposition grounds, etc., is an enthusiastic advocate of the broader forestry municipal development, as going hand in hand with landscape gardening.

"In a state like Massachusetts, where many park reservations like Mt. Tom, Wachusett, Greylock, Blue Hills, Metropolitan Park system, Mt. Everett, etc., have already been set aside for public purposes, if to these park systems, municipal parks, and forests be added as well as corporation and private forests, together with increased holdings for fish and game preserves, it is evident that conditions will be developed which will make our state greatly to be envied. What has been and may be accomplished in Massachusetts can be wrought with equal ease throughout the Union to a greater or less degree.

"Considering an imperative necessity for the growing of our future forest products, and considering the opportunity for business corporations and men to not only secure financial gain but bring great good to their respective communities, there certainly will be need in the future for all our well-directed acts of the present day. Is it not exceedingly fortunate that the conditions outlined do exist and that the solving of them offers hopes to the future? It is fortunate, too, that as a people we are ever ready and quick to respond to any undertaking no matter how strenuous the task, provided it will secure us benefit and reward. I have every hope, therefore, that our forestry problem will receive an early consideration at the hands of our people, and that all sections of the Union will do their respective parts in conserving the forests we already have and adopting modern methods of forest management as well as in reforesting lands unadapted to agriculture, returning them to forests for which to all intent and purposes they were created."

There has been of late much discussion on the subject of forests and their relation to stream flow and we could, if we chose, give

to you a sermon on this subject, but we have elected in this article to present to you the financial side of the question; in other words, the money profit which towns may obtain from lands which are now in their possession lying idle and unused. We believe that the time is not far distant when municipalities, like the state and nation, will take up forestry development in their midst, and that our towns and cities, like the communities of the Old World, will own their municipal forests. On the land which they have already acquired for the protection of a water supply is the place to begin.

Appended is given a list of 47 towns holding such lands, and the area held. Ten of these have sought advice from this office in regard to the management of their lands, and eight have in part carried out our suggestions, yet we are compelled to say that even these are only playing at forestry work.

No one is in a more fortunate position to practice forestry than a municipal water commission. It has as a rule no taxes to pay, the time element so detrimental to private ownership is wanting, because a municipality has, in theory at least, an everlasting existence, and the land which was bought as a protection for the water supply, from the forestry standpoint costs them nothing.

The Metropolitan Water Board has planted some 1 200 acres of land with pine and hardwoods at an average cost of $20.00 per acre. In addition, in the first ten years they have had to spend $6.00 per acre for improvement cutting, and about 25 cents per year for fire patrol. The studies of this office have shown that average land planted to pine will yield 46 500 feet per acre in fifty years, worth on the stump at present prices $465.00. Now let us balance these figures, figuring our investment at 3½ per cent., a fair average rate of interest on most municipal bonds.

		Stumpage Yield per Acre.
Cost of planting at $20 for 50 years, interest 3½ per cent. compounded	$111.70	$465.00
Improvement cuttings at $6 for 40 years, interest compounded at 3½ per cent	23.75	
Fire patrol 25 cents per year for 50 years, interest compounded at 3½ per cent	33.90	
Add to make even dollars	.65	
	$170.00	$465.00

This leaves a net balance of $290.00 profit per acre over and above 3½ per cent. return on the money invested, a rate of return equal to 7½ per cent., and this based on stumpage prices prevailing at the present time, and stumpage will certainly be worth no less fifty years hence. Will you not agree with us, that a town that holds land which is lying waste and idle, owned merely to keep some one from living on it, is committing a grave economic mistake when it fails to develop it into forest?

To take a practical example of the value that forestry can be to a town, Westfield owns 942 acres of land on its watershed in Granville, of which this office made a careful study. We found that 488 acres of this area were covered with some form of woodland and 454 acres were more or less cleared, 315 of which could be planted. We made our estimate of the income which may be derived from this land, giving its value at the time of cutting, basing the amount on present stumpage values.

Types of Land.	Area, Acres.	Stumpage Value.	Ready to Cut.
Large hardwoods	33	$2 640.00	Present.
Large pine	4	800.00	Present.
Medium hardwoods	36	3 000.00	10 years.
Medium pine	4½	900.00	12 years.
Medium pine and hardwoods	21	1 500.00	10 years
Culled land	160	15 000.00	25 years.
Small hardwoods	104	8 000.00	18 years.
Pine planted	315	108 000.00	50 years.

These figures when added show a net income to the town during the coming fifty years of approximately $140 000. To arrive at the net income on the planted land we have deducted $6 300 as cost of planting, $1 890 for improvement cuttings, $3 780 for fire patrol, and $26 500 for taxes on the planted land. Taxes on the woodland (it being located in another town) would have to be paid whether forestry work was carried on or not, so they were not deducted in estimating the returns on the forested land.

We cannot in the narrow limits of this article give the processes by which we arrived at the above conclusions, but ask you to take

them on faith, assuring you that we have done our best to be conservative in our estimates, basing them, as we said before, on the present values of lumber land.

This office has given suggestions to ten municipalities that have asked for our advice, and these suggestions have been embodied in written reports, in some cases in great detail. We stand ready to help any community in the state, the extent to which we will offer our services depending a great deal on how far the town will go in carrying out our suggestions after they have been made. The only cost to the town is for the traveling expenses of the man or men who make the examination and report. Most of the other states in New England have forestry officers who will give the same service, and where they cannot be secured there are firms of consulting foresters who can be called upon to give advice without excessive cost.

Municipal Water Supply Lands.

List of Cities and Towns which have Sought Advice from State Forester concerning Forest Management of Such Lands, and Record of Accomplishments to Date. All since Fall River Report of 1909.

City or Town.	Ownership. Municipal or Private Company.	Watershed Owned. Total Acres.	Existing Woodland. Acres.	Planting Accomplished. Acres.	Plantable Area Remaining. Acres.
1. Fall River,	City	2 940.6	2 507	5	433
2. Westfield,	Town	942.0	488	20	454
3. Holyoke,	City	2 200.0	1 400	12	800
4. Leominster,	Town	94.7	(?)	12	None
5. Fitchburg,	City	400.0	250	None	150
6. Amherst,	Company	131.0	(?)	35	(?)
7. Needham,	Town	91.6	50	5	35
8. Hudson,	Town	162.0	(?)	18	(?)
9. Milford,	Company	36.0	16	None	20
10. Pittsfield,	City	1 123.0	723	None	400

TENTATIVE LIST OF 37 CITIES AND TOWNS HAVING WATER SUPPLY LANDS POSSIBLY CAPABLE OF FORESTING. TWENTY-FIVE ACRES AND OVER.

(Project as yet unconsidered.)

Areas from State Board of Health.

City or Town.	How Owned.	Watershed Acres.
1. Adams	Fire District	33.5
2. Athol	Town	301.0
3. Attleboro	Town	300.0
4. Barre	Company	35.0
5. Billerica	Town	25.8
6. Brockton	City	225.0
7. Clinton	Town	197.5
8. Falmouth	Town	82.1
9. Foxboro	District	26.0
10. Hatfield	Town	40.0
11. Haverhill	City	668.0
12. Lenox	Company	167.0
13. Lowell	City	157.4
14. Merrimac	Town	31.0
15. Nantucket	Company	32.0
16. New Bedford	City	1 682.0
17. Newburyport	City	105.0
18. Newton	City	721.0
19. Northampton	City	786.3
20. Northbridge	Company	334.0
21. North Adams	City	3 942.9
22. North Brookfield	Town	144.8
23. Palmer	Company	40.0
24. Peabody	Town	98.6
25. Scituate	Company	42.0
26. Sharon	Town	216.5
27. Southbridge	Company	307.4
28. Stoughton	Town	56.0
29. Taunton	City	110.8
30. Uxbridge	Town	64.0
31. Waltham	City	40.0
32. Ware	Town	41.0
33. Westboro	Town	90.0
34. Williamstown	Company	96.0
35. Winchendon	Town	70.0
36. Worcester	City	442.0
37. Wrentham	Town	42.5

Add to the above the ten cities and towns which have already had advice from the state forester.

DISCUSSION.

THE CHAIRMAN. It gives me pleasure to call upon Mr. Nathaniel T. Kidder, president of the Massachusetts Forestry Association.

MR. KIDDER. *Mr. Chairman and Gentlemen,* — The hour is getting so late that I do not propose to give you a history or even a sketch of the history of our Association, but I do want to point out to you two or three ways in which I think it has been and will continue to be useful.

You would suppose from listening to the papers which have been read here to-day that we were all worked up in this state to a high degree of enthusiasm upon this subject, but you must bear in mind that you have been hearing from specialists. I want to say, in the first place, that the Forestry Association was largely instrumental in the institution of the office of state forester in Massachusetts. In the second place, the Association was instrumental, I believe, in introducing the tree warden into the various towns. He, in a small way, is the forester in the local community, and according to his amount of knowledge he does good.

You might further suppose, if you read over the laws of the state to-day, that there is sufficient law to regulate all these things; but you must remember that simply putting laws on the statute book does not necessarily do the work. Therefore, there is a great deal of missionary work to be done in educating the people up to these laws, and getting them not only to carry them out but to carry them out intelligently. Of course the number of officers to enforce the laws is rather insufficient, and we have got to rely a good deal on the enthusiasm of the people — and we are trying to educate them up to it. We are also trying to carry along legislation and enthusiasm together. We don't want either to get so far ahead of the other as to make difficulty, if it can be avoided. Our idea is that there is no use in putting a law on the statute books to-day which is going to be repealed next year as absolutely impractical; and so we want the people to coöperate and agree upon the general idea as to what laws are necessary.

MR. WILLIAM F. SULLIVAN.* Many of us have been practicing the methods that have been suggested, and put before us by the

*Engineer and Superintendent, Pennichuck Water Works, Nashua, N. H.

foresters and conservationists, during the past few years. I was particularly pleased with Mr. Rane's remarks with regard to the method of harvesting, and his view that the farmer should become a lumberman. I believe that the water-works people should become lumbermen and get as much as they can out of their forests. While a forest is "a thing of beauty," it is not "a joy forever," because it has not a much longer life than a man, and it has to be cut some time or allowed to waste. I have found, and foresters must have found, that we don't get the highest financial return, or that economical value spoken of by Mr. Rane, by following the ordinary farmer methods of simply going in and slashing. I think that is a point that should be taken up by the foresters with particular reference to instructing forest owners and water-works people, who have more or less timber land, how to get the highest financial return from what they have. Of course many water works have old growths; they should cut this and plant new stock, so that there will always be a mature growth to harvest periodically. At Hartford last April* we threshed this out to some extent, and some of the lumbermen were not impressed with the idea of water works owning their own equipment, as is recommended. But I believe that where a water works owns a surplus water power it is wise, for many reasons, to put in a water-power mill. We have begun the erection of such a mill to take care of the timber that we intend to cut. We have put in the head works and expect in a short time to have a mill for ourselves and for the small farmers in the vicinity who may wish to bring their logs to us to be cut.

* JOURNAL N. E. W. W. A., Vol. XXIV, p. 345.

PRACTICAL FORESTRY FOR WATER WORKS.

BY EDWARD SOHIER BRYANT, CONSULTING FORESTER, BOSTON, MASS.

[*Read March 7, 1911.*]

Most of the land on the protective areas which you control may be classed as agricultural land, brush land, sprout land, woodland, marsh land, and newly made land.

I believe most of you do not favor agriculture on your lands, as the plowed land is apt to be badly washed in the spring of the year. The snow, and the surface layers of the soil, melt under the spring rains before the frost has left the lower layers of the soil. This brings an objectionable amount of sediment into your reservoirs — and this is especially true where the land is heavily manured, as it must be to carry on successful agriculture. Therefore, the only agriculture possible for most of you is the annual cutting of hay lands. As the hay lands run out, their only agricultural use is for pasture, and finally, as they gradually deteriorate, they are reduced to brush land.

All of your brush land and any pastures which are yielding poor feed and small returns can probably be put to more profitable use by planting them to white pine.

Probably, in the case of those of you who control the largest protective areas, a large proportion of your territory is sprout land. Often such land has been bought by your companies, with the privilege of cutting the timber reserved to the owner. For this land there is no treatment practicable except to let it grow up with perhaps the addition of a few hundred white pine-trees per acre scattered in the openings between the bunches of sprouts.

I understand that the best practice to-day for the protection of watersheds involves the draining of all swamps so that where these are wooded they are converted into what I have termed woodland. Where there are open meadows, the draining practically puts them in the same class as newly made land. By this term I mean to designate the land which you have made by exca-

vating peat and mud from the beds of your reservoirs and piling it on the adjacent low lands. All of this newly made land, if well drained, is suitable for planting with white pine.

Woodland that is found in the protective areas of the water works of New England cities and towns consists largely of sprout hardwoods often reinforced in the older stands, to some extent, by a natural understory of hemlock or of mountain laurel.

In many cases the prevailing popular impression that it is a good thing to burn over, every year, hardwood land, and even pine land, has been further strengthened in the minds of water-works men in their effort to keep the hardwood leaves out of the reservoirs. The damage that burning over the woods every year causes is not readily apparent to men whose chief interest is not in the woods. They fail to notice that the quality of the woods as a timber-producing machine is lowered each year, and that the water runs off quicker, year by year, bringing a larger and larger amount of silt into the reservoirs. The proper solution of the leaf nuisance lies not in annually burning the leaves, but in cutting away some of the hardwood trees along the edge of the reservoirs and planting white pine, Douglas spruce, and hemlock to catch the leaves. The softwood trees do not make an objectionable amount of litter in the water and their dense evergreen foliage serves to keep the hardwood leaves from blowing into the reservoirs.

In managing your woodlands on forestry principles you have the advantage over all other forms of ownership in the fact that neither the taxes on the land nor a high interest rate are really chargeable against the forestry work. If the land were bare, and kept bare, the water companies would still have to pay taxes on it in order to protect the quality of the water. Such large stable public service concerns can borrow money at an interest rate that is far more favorable than that of any other forest owner except the state. You must also maintain patrolmen to keep your watersheds from pollution. These men can serve without additional expense as a fire patrol, to detect, report, and extinguish forest fires. You have men on your summer pay-roll whom you want to keep with you. By giving them a job of cutting cordwood, by the cord, you can help them without raising the cost of improving your woodland. Your holdings must be relatively near large

cities. That means abundant labor, cheap transportation, and an unlimited market for your products. There is no owner better situated to practice forestry than the water companies and the municipally owned water works.

Hardwood land does not retain water so well as softwood land. The softwood trees, by shading the ground all winter, retain the snow better. Their foliage keeps the warm air under them from cooling as quickly or as much as it does in the hardwood land. The mat of fallen needles on the ground keeps the frost out of the soil. Their dense foliage keeps the wind and sun from drying off the winter's accumulation of snow at the top. When a rain or warm thaw comes, the snow melts off at the bottom and the water sinks into the soil gradually, to be slowly added to your water supply through springs instead of rushing down over the surface all at once in spring, at the very time when your reservoirs are already overtaxed by flood waters from agricultural lands farther upstream. Hardwood trees evaporate from their foliage far more water during the summer than a similar area of softwood trees.

Of all the softwoods, white pine is the most profitable to grow in this region. From the time that a plantation first reaches a commercially marketable size at from twenty to twenty-five years of age it does not cease to yield an annual increase in its money value over that of the year before of over eight per cent. until it is fifty years old.

For this reason it is desirable to plant white pine as much as possible wherever planting is advisable. It is also desirable to replace the hardwoods by pine as quickly as possible; all the more so, as the white pine is not subject to attack at all by the brown-tail moth and in pure stands it is not damaged by the gypsy moth.

It will pay you to market much of the smaller material as thinnings, and concentrate the growth of your hardwoods in the best specimens until they are ready to be made into saw timber. Then underplant the open growth of hardwood with white pine seedlings a couple of years before making the final cutting of the old hardwood. When the old hardwood is removed you have a pine plantation already started which only needs the filling of a few blanks where the small pines have been killed, and a small amount of

brush cutting in about three years, and six years later, to leave it in good condition to grow until it is thirty years old.

There is only one spacing of white pine-trees that is commercially practicable and that is about six feet apart each way. If they are planted closer than that they soon become too crowded, and long before the material which must be removed in a thinning has any commercial value they become too spindly and stunted to grow at a profitable rate. The expense of close planting is also enormous. If white pine is planted at a greater distance apart than about six feet it grows limby and bushy and is subject to great damage by the pine weevil. Plantations set out six feet apart each way grow straight and with small knots at a maximum rate until they are about thirty years old, when they begin to be crowded. At that age, however, the trees which must be removed are large enough to make salable cordwood.

To sum up, therefore, I would advise you, — to keep out fire from your lands, to plant pine along the shores of your reservoirs and streams, to thin your older stands of hardwood and underplant them with pine before finally cutting them, and to plant up with pine all open areas that are not yielding a fair return. You can both make money by growing timber and at the same time improve your catchment areas.

DESIRABLE PRESSURE AT HYDRANTS.

BY E. V. FRENCH, VICE-PRESIDENT AND ENGINEER OF THE ARKWRIGHT MUTUAL FIRE INSURANCE COMPANY, BOSTON, MASS.

[*Read April 12, 1911.*]

The main purpose of a fire hydrant is, of course, to furnish water for extinguishing fires, and the problem for solution is, What is a desirable pressure to have at our hydrants under various conditions? If steam fire engines are to be depended upon, then but a few pounds' pressure may suffice to force the water out of a hydrant as fast as a steamer would use it. It is true that a somewhat higher pressure helps the steamer, but this is not essential. The cities of New York, Philadelphia, and Chicago for example have very low pressure supplies. In these cases the pipes are little more than underground canals to which the steamer gets an inlet through the hydrant. New York and Philadelphia already have special high-pressure systems for fire use only. Other cities having low-pressure supplies are considering the special high-pressure fire-fighting system, for where there are very large concentrated values, sole dependence on low-pressure water and steamers has not been considered to give sufficient protection.

If fire engines are not to be relied upon entirely, then there must be sufficient pressure at the hydrants to furnish good fire streams. The standard fire stream to-day is that discharged by a $1\frac{1}{8}$-in. smooth nozzle, with a pressure at the base of the nozzle of 45 lb., giving 250 gal. per min. This is the size of stream best adapted for all ordinary work, and for most of the work in any fire. With very large and high buildings a few larger streams are generally desirable and can be obtained by siamesing several lines of hose or, in the larger cities, by the use of 3-in. hose or occasionally larger sizes, such as is sometimes used with fire boats. In dwelling-house fires smaller nozzles can sometimes be used to advantage.

The pressure needed at the hydrant to furnish a standard stream depends on the length of hose. Two and one-half inch cotton rubber-lined hose, now almost universally used in fire department work, causes a loss by friction of about 14-lb. pressure per 100 ft. of length of hose with 250 gal. flowing. This is for hose having a smooth rubber lining. Some hose is sold in which, because of faulty methods of manufacture, or a desire to unduly cheapen the product, the rubber linings are not well backed up and a very rough interior results. Such hose may cause a loss of nearly double this amount. Of course such inferior hose should not be used. The standard fire-stream tables developed some years ago by Mr. John R. Freeman, after a very elaborate series of tests, show the hydrant pressures needed with various lengths of hose to discharge 250 gal. per min., through a $1\frac{1}{8}$-in. smooth nozzle to be as follows:

Length of Hose. Feet.	Pressure at Hydrant must be, Pounds.
100	63
200	77
300	92
400	106
500	120
700	149
1 000	192

With pressures at the hydrant maintained while the stream is flowing, of 60, 80, and 100 lb., the height of the stream as an effective fire stream,— that is, before it spreads too much into spray, — with various lengths of hose, and for moderate winds, will be as in the following table. Higher winds will very materially lessen the effective height. The horizontal reaching distance of such streams will be about 10 per cent. less than the effective height. This reaching distance is, of course, important in the case of wide buildings, the necessity to throw streams across streets, work from ladders, etc.

PLATE I.
N. E. W. W. ASSOCIATION,
JUNE, 1911.
FRENCH ON
DESIRABLE PRESSURE AT HYDRANTS.

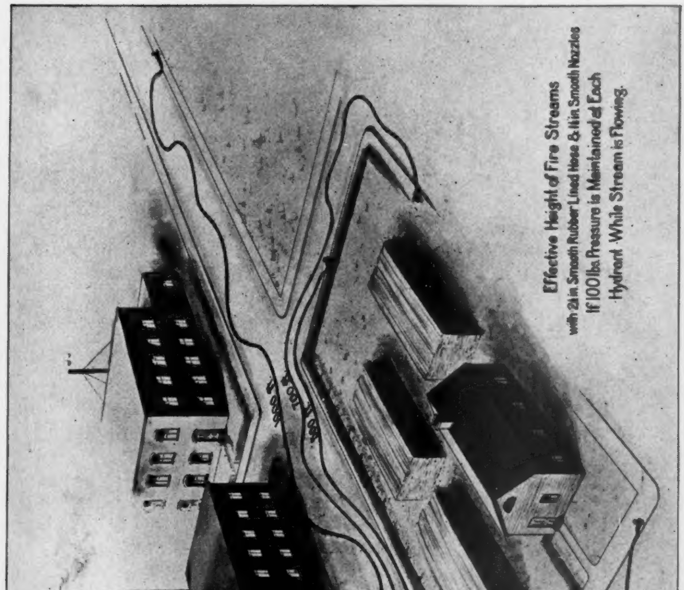


PLATE II.

N. E. W. W. ASSOCIATION,

JUNE, 1911.

FRENCH ON

DESIRABLE PRESSURE AT HYDRANTS.

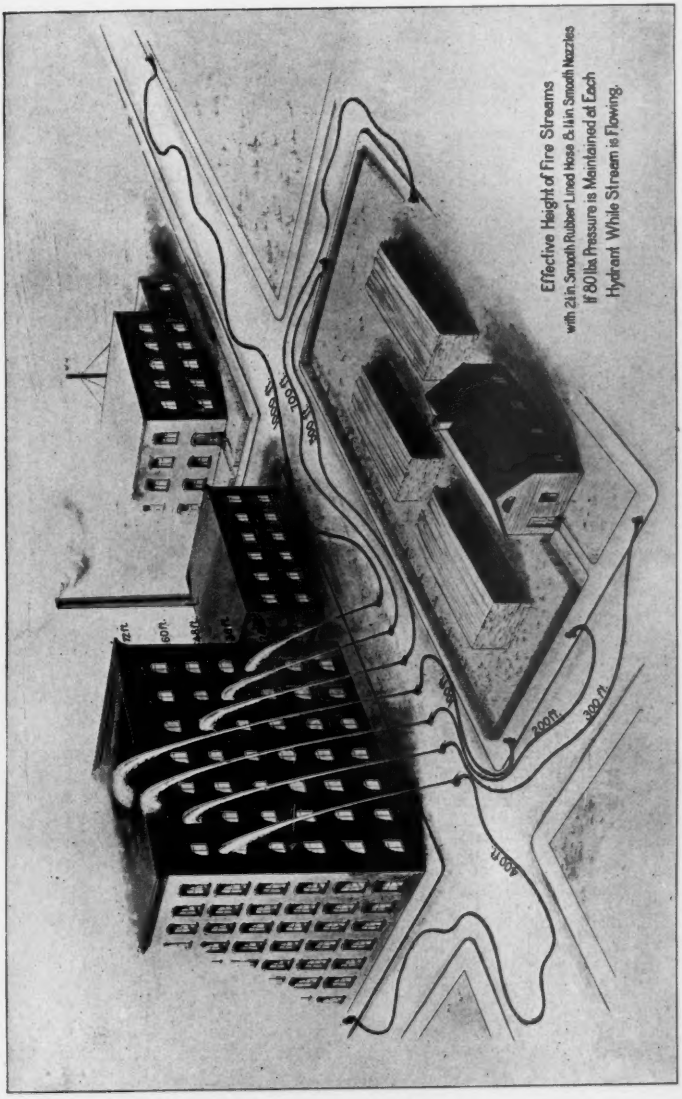

Effective Height of Fire Streams
with 2½ in. Smooth Rubber Lined Hose & 1¼ in. Smooth Nozzles
If 80 lbs. Pressure is Maintained at Each
Hydrant While Stream is Flowing.
100 ft.
200 ft.
300 ft.
400 ft.
500 ft.
600 ft.

PLATE III.
N. E. W. W. ASSOCIATION,
JUNE, 1911.
FRENCH ON
DESIRABLE PRESSURE AT HYDRANTS.

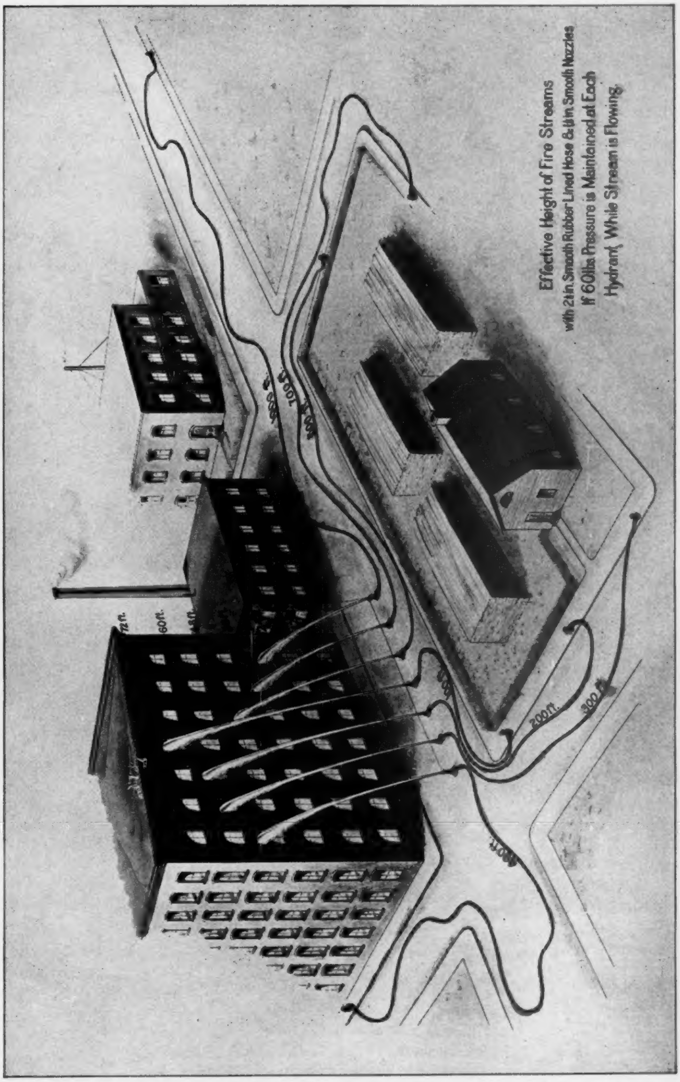
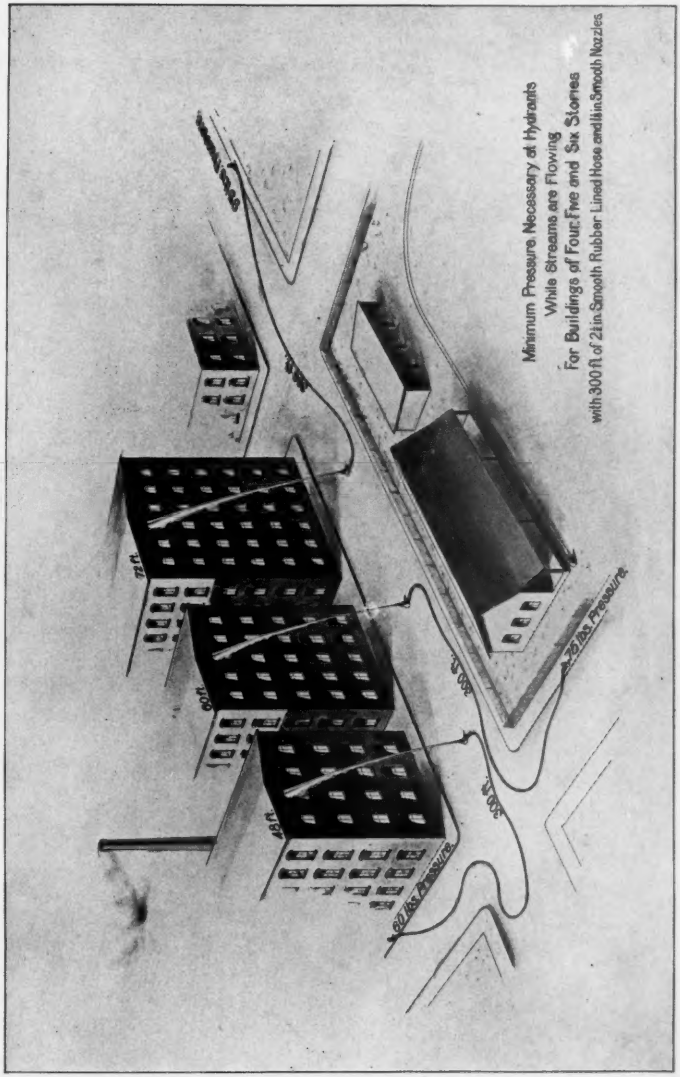


PLATE IV.
N. E. W. W. ASSOCIATION,
JUNE, 1911.
FRENCH ON
DESIRABLE PRESSURE AT HYDRANTS.


Minimum Pressure Necessary at Hydrants
While Streams are Flowing
For Buildings of Four, Five and Six Stories
with 300 ft. of 2½ in. Smooth Rubber Lined Hose and 1¼ in. Smooth Nozzles
60 lbs. Pressure
70 lbs. Pressure
300 ft.
300 ft.

EFFECTIVE HEIGHT OF STREAMS.

1¼ Inch Smooth Nozzle. Length of Hose.	LIMIT OF HEIGHT WITH MODERATE WIND AS GOOD EFFECTIVE FIRE STREAM.		
	With 100 lb. at Hydrant.	With 80 lb. at Hydrant.	With 60 lb. at Hydrant.
(Feet.)	(Feet.)	(Feet.)	(Feet.)
100	88	82	67
200	82	72	59
300	74	65	52
400	67	58	44
500	62	52	40
700	53	43	33
1 000	42	34	25

This can all best be illustrated by diagrams plotted from the fire-stream tables and showing the effective height of streams thrown from the street upon a six-story building in which the height of stories is assumed to be 12 ft., bringing the roof 72 ft. above the street level. It is then assumed that the streams are supplied from hydrants located on the adjacent streets with hose lines varying from 100 to 1 000 ft. in length. In the first three diagrams the hydrant pressures are assumed to be maintained — in the first case, Plate I, at 100-lb. pressure; in the second, Plate II, at 80-lb. pressure; and in the third, Plate III, at 60-lb. pressure. This would of course mean that the mains supplying these hydrants were of such size that the pressure would be about the same at all of them.

The diagrams well show the effect of the length of hose on the height of the stream. It is, of course, true that the highest drops would go considerably higher, but the real value of the stream must be measured by its limit of height as a fairly compact mass of water, able to go through windows and strike the ceilings of the rooms with sufficient force to be thrown over a considerable area. It is this limit which was carefully determined in the making up of the standard tables, and in determining the effective heights.

For any ordinary fire fighting, even where the hydrants are spaced closely together, hose lengths of 250 to 350 ft. will be neces-

sary. This gives sufficient leeway for going around corners, into alleys, up ladders, etc., and is essential for reasonable facility in getting at the fire. It is fair to take an average of about 300 ft. as the length of hose usually needed. Plate IV has been plotted to show the hydrant pressures necessary with hose lines 300 ft. in length for buildings of four, five and six stories in height. It is seen at once that to reach the top stories under these conditions the hydrant pressures *while the streams are flowing* would have to be 60, 75, and 95 lb., respectively.

There will always be some loss of pressure in the mains, and an unavoidable loss of 2 or 3 lb. in the branch to the hydrant and through the hydrant itself. A total drop in pressure of 10 to 15 lb. due to friction in the general pipe system, including the loss into and through the hydrant, would be reasonable, but even this would require large supply mains, and a great many systems to-day show a much larger drop in pressure than this for considerable fire drafts. The ordinary pressure must therefore be enough above these pressures so that, with the friction losses which the heavy drafts of a large fire cause, the hydrant pressures will not drop below these points.

AMOUNT OF WATER NEEDED.

The number of streams likely to be required must, of course, be determined in laying out any system. For almost any condition 6 streams would be a minimum, requiring 1 500 gal. per min. As soon as the built-up section of a town or small city comes to be somewhat closely covered and of moderate area a capacity of about 10 streams, requiring 2 500 gal. per min., is needed. In our cities of medium size, such as Springfield, Lynn, and Worcester, provision should be made for 20 to 30 streams, and to give a good margin for water used by automatic sprinklers, inside standpipes, or wasted through broken connections for ordinary services, such as are sure to occur in any considerable fire, an available capacity of 10 000 gal. per min. has been generally advised and is necessary for reasonable safety, with the construction now common in cities of this general type. These quantities of water must, of course, be delivered in addition to the normal consumption of the community.

Such large amounts of water would only be needed in the congested sections, which are the high-value districts, and the pipe sizes supplying these sections must be able to deliver such quantities within the limits of about 10 lb. below the regular static pressure unless the normal pressure is carried much higher than needed, which is not generally advisable.

The total amount of water used in even large fires is not as great as frequently thought. A fire, for example, requiring 10 streams for five hours would use 750 000 gal. However, the rate of draft for fire fighting is frequently high in comparison with the ordinary consumption. Three standard fire streams discharging 750 gal. per min. use water at a rate of a little more than a million gallons a day, and 10 streams mean a rate of flow of about three and one-half million gallons per 24 hours. Pipe sizes must, of course, be proportioned for the maximum rate of demand which any fire is likely to cause.

LOCATION OF HYDRANTS.

It is also of vital importance where hydrants are to be depended upon for fire streams that they should be so near together that the whole capacity of the water supply may be concentrated on any point where the total strength of the system may be needed, and this should be possible with the use of hose lines generally not over 300 ft. in length. This would usually require hydrants much closer together than is the usual practice. Hydrants are, however, much cheaper than hose or steam fire engines. Where steamers are depended upon it is very common to use hose streams 500 and 600 ft. in length, and frequently longer, but this is undesirable, even with steamers, and a great waste of energy is absorbed simply in friction. With ordinary hydrant pressures depended upon, such needless losses cannot be tolerated.

From the above study it is evident:

> *First*, that for the general conditions found in our cities and larger towns, the ordinary static pressure at hydrants in the business and manufacturing sections, which best meet the conditions as a whole, lie between 80 and 100 lb. A pressure of 80 lb. will do very good work for smaller com-

munities; 100 lb. is needed for the general conditions of cities rather above medium size.

Second, pipe sizes must be such that the maximum amount of water needed in any section can be supplied without reducing the pressures at the hydrants more than about 10 lb. below the ordinary static pressures existing with every-day drafts.

DIFFERENT ELEVATIONS.

It often happens that there are considerable differences in elevation within the limits of one town or city. It is desirable where possible to so fix the pressure that a single system will supply all sections. This gives the simplest and most efficient arrangement of distributing pipes. In such cases, in order to get an efficient pressure in the higher portions, which would generally be the residential sections, it may be necessary to let the pressure in the lower parts be considerably above 100 lb., and this can be done without difficulty. At Fall River the pressures along the waterfront range from 100 to 127 lb. At Worcester a high-service system is available in a large part of the city and the pressures range from 140 to 150 lb. At Fitchburg the pressures average about 140 lb., running up to 150 in a number of places. These are high pressures and above what would ordinarily be recommended for a general public service, but they have been maintained and used by the regular consumers for years without special difficulty. The arrangement of the new water supply for Springfield, which gives 140 lb. throughout the business district, with pressures of 75 to 80 lb. for most of the residential section, is an excellent example of different levels supplied by one system. It provides excellent fire protection and will undoubtedly prove satisfactory from practically every standpoint.

Experience shows that there is no serious difficulty in maintaining pipes and fittings within the limits of the above pressures. Further, that it is possible to change from a lower pressure to a materially higher one without any really important difficulties. With reasonable care there is no need of any great increase in leakage or in breaks, especially when starting new. Where the

water has to be pumped it would cost somewhat more to raise it to the higher elevation, but with modern efficient pumping machinery the difference is not great and the whole cost of pumping is relatively small in comparison with other costs which our water departments must meet.

ADVANTAGES.

The first and principal advantage from hydrant pressures of 70 to 100 lb., and sometimes higher, comes from the immense improvement in fire protection which is secured above that obtainable with low pressure and dependence on fire engines. Each hydrant becomes practically the equivalent of the average steamer; lines of hose can be attached to a hydrant and water put on a fire much more quickly than if a steamer has to be set, connected, and put in operation. If the progress of a fire makes it necessary to shift hose lines this can be done much more expeditiously than if a heavy fire engine has to be moved. When a conflagration threatens to sweep our cities, as at Chelsea and Baltimore, hose carts can quickly lay lines in different sections, making it possible to surround and drown a fire which would get away in the time lost by moving steamers and getting them in operation. Radical improvements in construction would be the best way to stop conflagrations, but this is a remedy which will come but slowly, and until our standard is greatly improved there is nothing which would give the probability of checking a conflagration so well as good pressure available at every hydrant supplied by pipes of such size that each hydrant could at any moment furnish two, three, or four efficient fire streams. Strong water supplies also very much increase the value and efficiency of sprinkler equipments.

A town or city with such a water supply can make a very material saving in the cost of its fire department over what would be necessary with low-pressure water and sole dependence on steam fire engines. In such a city it would in many cases be necessary to keep only a few steamers in service and in some cases none at all. Such steamers as were needed would usually respond to only a few boxes in the more hazardous sections, so that in the main these steamers would be practically in reserve, and could be main-

tained at a minimum cost. Figures obtained in two cities under good average conditions showed the cost for maintaining fire apparatus to be about as follows:

Yearly cost of maintaining a hose wagon about	$4 000
Yearly cost of maintaining a steam fire engine and a hose wagon	8 000
Yearly cost of maintaining a steam fire engine without a hose wagon,	4 600
Yearly cost of maintaining a steam fire engine in active service beyond what it would cost to maintain it in reserve about	3 400

These figures include the cost of the men, the horses, repairs, and all ordinary expenses, together with a proper amount of interest, and sinking fund charges for the house or the part of the house occupied by the apparatus in question.

It will be seen from these figures that a very material saving in annual cost is possible, and when this can be done with an increase in the efficiency of the fire depatrment the gain is most satisfactory. This saving would generally more than pay for any additional cost in the annual charges for the water department, and would in some cases also pay considerable interest and sinking fund charges on the cost which might be entailed in changing a low or moderate system for one of good pressures, such as are believed desirable.

SPECIAL HIGH-SERVICE SYSTEMS.

Such a system using separate pipes from those of the ordinary water works, and designed exclusively for fire fighting, with water supplied at pressures which may go as high as 200 or 300 lb. may be justified in ten or twelve great cities of the country, where enormous values are concentrated, and warrant the maximum protection. It is not believed that such special systems are warranted in the great majority of our cities. The cost entailed would often be ample to put the usual system on a good pressure basis which would give most efficient fire protection. When this is done the whole city gets the benefit, whereas in general the special high service must be limited to a few districts. This method gives greater simplicity, efficiency, and probably in general at lesser cost. If it is coupled with a judicious requirement

for automatic sprinklers in dangerous buildings which may be fire breeders, more will be accomplished than by any special high-pressure fire system which could ordinarily be provided.

GRAVITY SUPPLIES BEST.

A gravity supply of water is the best thing for fire purposes. A reservoir of good capacity or a large standpipe gives a reserve supply already stored at the higher elevation and available to meet any sudden large demand. Water thus stored is, we may say, capital on hand, giving strength to meet any emergency, whereas the best pumping equipment must depend on the right action being promptly taken when special demand arises, and there must be very large reserve capacity to meet possible heavy calls which would come but rarely.

We found in studying this problem at Lynn that it was now possible to build very large standpipes of concrete, and these may well be used in those cases where there is not a suitable site for a large reservoir which would be generally preferable where feasible. Standpipes holding as much as 8 000 000 gallons can be built, and reputable concrete men are ready to guarantee them. We considered two sizes, one 125 ft. in diameter by 90 ft. in depth of water, another 150 ft. in diameter by 60 ft. depth of water. Such standpipes can be built at a cost of $100 000 to $125 000; the capacity of each would be about 8 000 000 gal.

Twenty years ago tanks for fire purposes in our factories of 5 000 gal. were common. To-day steel tanks of 50 000 to 100 000 gal. and steel trestles from 75 to 125 ft. in height are regular productions, like any other commodity, and are commonly used where tank supplies are necessary. In the same way the development of our water-works systems should go beyond the small standpipe of 200 000 or 300 000 gal. to standpipes of several million gallons, or to larger reservoirs wherever they are available.

Such water supplies delivered at good pressures will give our communities greatly increased fire protection, and in general stronger and more satisfactory water-works systems.

DISCUSSION.

THE PRESIDENT. Mr. French's statement that in many cities money can be better spent in improving the regular water-works system to make it sufficient for ordinary fire requirements than in putting in a special high-pressure system is most interesting and important. I have had the feeling for some time that the policy outlined was a wise one for many of our cities, and I have encouraged it in several cases.

Mr. French also made an interesting statement to me privately before he spoke, to the effect that if such automatic sprinklers as are required in the factories insured by Mr. French's companies had been installed in a certain factory building in New York City, the fire which occurred in it, with a dreadful loss of life, a few weeks ago, could have been entirely prevented.

Most of you know of the work of the National Board of Fire Underwriters. They send their men to test your water supply systems, find out where they are weak, and tell you how they may be improved. I think some of you have an idea that, whatever size of pipe you propose to lay for your mains, the insurance people will recommend one size larger.

We are fortunate in having with us Mr. Booth, representing the National Board of Fire Underwriters. I will ask Mr. Booth to explain this and other matters to you.

MR. GEORGE W. BOOTH. *Mr. President and Gentlemen,* — I am sure there is some misunderstanding in regard to what your President has just said, because I looked over the plans of the Springfield distribution system this morning, and I am sure I would not recommend any larger pipes. I was in some doubt before Mr. French read his paper as to whether I was going to be able to agree with him on all points, but after I have heard him read it I do not remember that there is anything with which I cannot entirely agree. There are some points, however, to which I should like to call attention.

I suppose there is nothing which has been the subject of more debate among the engineers of the National Board of Fire Underwriters than this question of hydrant pressures. The debate has been not so much on the possibility of securing good protection

where good pressures exist, but whether it was fair to expect, or whether it could be expected, that the fire department could and would make such use of those pressures as to secure effective results. There are several reasons why a system having a pressure of 80 to 100 lb. to the square inch does not always give such results. Perhaps one of the commonest reasons is that the mains are not large enough to maintain that pressure under heavy draft, which, after all, is the real test of a system, and the idea on which it should be designed; or because, where direct pumping is depended on, there isn't sufficient pumping capacity. Not all cities have been as courageous as Springfield in securing high pressures. The ordinary pressure, where direct hydrant streams are depended on alone, of from 80 to 100 lb. will very likely not be maintained under heavy draft, but will drop, perhaps, 20 or 30 lb.

Another reason why a system nominally able to give good service does not give it, is the poor hydrant distribution. So far as my inspection of hydrant spacing in Springfield goes, I think that that criticism could not be made with justice here. But in most cities, especially outside of New England, the length of some of the hose lines which it is necessary to use in furnishing the number of streams desired will run up as high as 800 or 1 000 ft., and these diagrams that Mr. French has prepared show you what kind of a stream can be secured through such hose lengths, even under the best conditions. Moreover, since a conflagration, which demands the greatest supply, is apt to occur under adverse conditions, perhaps high winds or other conditions which detract from the efficiency of the system, there is still further reason for not getting as good results as should be obtained.

Another point that is sometimes of considerable importance is the loss of head in the hydrant. We have found cases where the loss of head has been 20 or 30 lb. And that is not to be wondered at when you take into account some of the hydrant connections. I think one of the worst I can remember is a case where the hydrant was connected with the main by three $\frac{3}{4}$-in. pipes. Naturally you wouldn't expect to get very much water.

As concerns hydrant pressures on separate fire main systems, most of these systems provide for an ultimate pressure of 300 lb., but I think the maximum has never been used. The highest I

can recollect was during three simultaneous fires in New York, when they were carrying a pressure of 225 lb. at the pumping station, and as they were delivering something over 30 000 gallons a minute, it was rather necessary that a high pressure should be maintained. What we have in mind is, that while, perhaps, under the best conditions 100 lb. will give you good fire service, we feel safer if there is something more back of it, for use if necessary under adverse conditions.

I am able to agree with Mr. French on another point, and that is that there are, perhaps, only ten or a dozen of the biggest cities in the country which really stand in need of a high-pressure system such as has been put in in Philadelphia and New York. I believe if you will look over the reports of the National Board you will find in a great many of them that reference is made to the fact that money can be spent to better advantage by bolstering up the old systems and increasing the pressures than by putting in separate systems.

THE PRESIDENT. This Association some years ago adopted a uniform hose coupling, which is described in one of our JOURNALS,* and is a very vital matter, because when there is a big fire in one of our cities and we want the fire engines from other cities to come and help us, if the connections for different hose are different, as they all used to be, it is a very bothersome matter, and may greatly interfere with or entirely prevent advantage being taken of assistance. Mr. Griswold is here to-day and has something that he wants to show to the members of the Association in that line.

MR. F. M. GRISWOLD.† A committee was formed some years ago with the idea of proposing a thread which would be universal on $2\frac{1}{2}$-in. hose couplings. In going over the past work in relation to standardizing the thread, we went back to 1873, when the chief of the Fire Department of Cleveland, Ohio, proposed a standard. For some reason, I don't think from any scientific knowledge on his part, he picked out a thread of $3\frac{1}{16}$ in. outside diameter over the male thread with $7\frac{1}{2}$ threads to the inch. It is an odd combination, but, as has been said by a great many people, it has proven to be a mechanical anomaly. For instance, you cannot

*JOURNAL N. E. W. W. A., Vol. XX, p. 348.

†Of the Home Insurance Company of New York, N. Y.

put a 6 and 7 thread together, nor can you put a 7 and 8 thread together, but you can use in a 7½ female thread the 7 and 8 male thread of the same outside diameter, even if they have not been machined to make a better fit. In other words, a full $3\frac{1}{16}$-in. outside diameter male of 7 threads will go into the 7½ female of the same diameter sufficiently for an emergency coupling, and with the pressure that may be put on the soft metal with a spanner it can be run down to within about one thread of a complete connection.

This city of Springfield has just demonstrated the practicability of changing from a snap-coupling, — the Universal, I believe it was. If you drop a heavy snap-coupling on a stone pavement, it is liable to jamb the edges, so that you cannot make a good joint, and every section will leak at the coupling. Here in Springfield they have changed the couplings on over 1 350 fire hydrants and over 22 000 feet of hose, so that this city has the National standard coupling. This coupling does not have any one's patent behind it, it is absolutely an open device with nothing in it for anybody, and anyone who knows how to make a coupling can make it.

It is one of the easiest things in the world to-day to use a 7 or 8 thread within the range of a $3\frac{1}{16}$-in. outside diameter or even of 3 1/32 in. or 3 1/64 in. where the inside diameter of the hose coupling itself is not greater than 2½ in. Of course, if you increase the inside diameter, you reduce the shell, and if you knock anything off that shell you weaken it so that, perhaps, in drawing the hose you may break it. But so long as the interior is 2½ in. or less, and your outside diameter is $3\frac{1}{16}$ in., you may very readily and very serviceably change a 7 and an 8 thread to fit the 7½ female thread. It is not necessary to remove the nipple from the hydrant, nor the coupling from the hose, to accomplish these results. A tap and die that is designed to the number of threads you are operating on will do the work of reduction, which may be accomplished by the firemen themselves at odd times.

This is the sixth year, I think, that this committee has been at work. We were very pleasantly told, when we were appointed, that we might accomplish something in twenty years, but I am glad to say that inside of twenty months we had all the leading

authorities, — the American Water Works Association, the New England Water Works Association, the International Association of Fire Engineers, the National Association of Fire Engineers, and many municipal societies, — all approving it, and now this city has given us a demonstration of the method by which the National Standard may replace the non-standard coupling. I can report to-day that a new record which our committee has just issued shows that there are seventy-eight places from which we have learned that the change from non-standard to standard couplings has been made, — that is to say, either by adopting the standard for new installations, or by trimming down their 7 or 8 thread to fit the 7½-in. female. I imagine if everybody from whom we have heard in relation to couplings had taken the trouble to tell us whether they had changed or not, we might have one hundred and seventy-seven on the list. No water-works superintendent or fireman who has charge of a system need feel afraid of making this change when the opportunity offers. It is a matter of little expense, and it absolutely helps you in getting assistance from your neighbor when you need him, and helps your neighbor when you go to help him. You recall, perhaps, that at the time of the Baltimore fire the New York Fire Department went down, but it was absolutely of no service to Baltimore until it got to the open water of Jones's Falls, where it could make suction. Previous to that their suction hose was tied to the hydrant outlet by wire, and a horse blanket tied over that, so that the engines could get some water, but not much. When they got down to where they could get open water, they did very efficient work.

I trust that you will not forget that this is as much the baby of the New England Association as it is of the National Fire Protection Association, and that our committee will help you wherever it is necessary, and will be very glad to.

THE PRESIDENT. I hope that every member of the Association will use his influence in every proper way to secure the adoption by our cities of this Standard thread, which the Association has adopted.

MR. GEORGE A. KING.* There was one point, Mr. President, which Mr. Booth touched upon which it seems to me should be

* Superintendent of Water Works, Taunton, Mass.

considered by all of us in designing our arrangement of hydrants and their connection with the mains; that is, the loss of pressure due to friction in the connection from the main through the hydrant. I think that the design of the tee connecting the main, and the size of the connection with the hydrant, are worthy of more consideration than we have been giving them, at least in our city.

There is one other point which I wish Mr. Booth might give us some information upon. I have examined, I think, from seventy-five to one hundred reports of the Board of Fire Underwriters, and in every one of them they speak of the desirability of keeping a record of the gate inspections. In the reports which I have examined I think half a dozen cities are mentioned as keeping a record of the gate-valve inspections, but I have written to every one of those places, and I have got from only one a form in which that record is kept, that is, Omaha, Neb. Utica, N. Y., has sent me a sketch of what they propose to use, and those are the only two places from which I have obtained any idea of what system is employed, and, so far as I have been able to learn, they are the only places in which any record is kept of gate inspections. I would like to know what the Board of Underwriters would like to have done in that line.

MR. BOOTH. There are not many places, perhaps, where they do keep such a record, but I know of perhaps half a dozen, and I will be glad to look the matter up and send you what seems to be the best form.* The reason for keeping such record is, of course, pretty evident. It is well illustrated by a report which came in from one of our large cities a little while ago, that out of, I think, about 7 000 different gates inspected, 70 or 80 were found closed altogether, probably because the men who had operated them had gone away and forgotten all about their being closed. Besides those 70 or 80, there were a large number which were partly closed. If a record is kept of every operation of a gate, it isn't nearly so likely that the man who closes it, perhaps to repair a break in the main, will go off and leave it closed.

I think it is not nearly as much of a task to keep the record as you may think. It is kept in a number of places. I know it is kept in New York, at least on the high-pressure system. I haven't

* See pages 276 and 277.

in mind just what the places are, and cannot tell just what the form of the record is.

MR. MORRIS KNOWLES.* I take it, Mr. President, that there is no serious disagreement between Mr. French and Mr. Booth in regard to the necessity of some things other than high pressure; further, that Mr. French will agree with Mr. Booth that it is necessary to have the mains adequate and the sources of supply sufficient, whether from pumps or reservoirs. Mr. Booth has touched upon one other point which I think needs emphasis, and that is the distribution of the hydrants. Generally, the lack of a proper distribution, or lack of a sufficient number of hydrants, may be attributed to the method of paying for fire protection service. This may not always be true in municipal supplies, at least where nothing is paid by the city itself to the water-works' finances for the use of hydrants, but it certainly is true where the municipality is supplied by a private corporation.

As you all know, the usual basis of payment for fire service provides an annual rental at so much per hydrant, and the number of hydrants is determined by the choice of the municipality. In making the original contract, they may have started out with a certain minimum number of hydrants. As the city grew, and most of our cities have grown very rapidly, they may not have changed the contract, at least so far as the minimum number is concerned. Consequently, the municipality, desiring to keep the price as low as possible, has made an effort to keep the number of hydrants at the minimum.

It seems to me the compensation for fire service should be differently arranged than is customary. Let it be recognized that payment should be based upon the ability of the plant to furnish sufficient water at good pressure, and not merely upon the cost of a certain number of hydrants. The number of hydrants should not be made the basis of payment, any more than should the quantity of water consumed for fire purposes be considered as a proper measure of the fire service rendered. It is possible and practical to estimate the value of this service in any given case. This cost may be paid in several ways, as a lump sum, or per mile of main, or in any similar manner which may be thought advisable,

*Consulting Engineer, Pittsburg, Va.

but the important point is to have it understood that the real basis is the protection afforded and not merely the number of hydrants in use — then, and not until then, will the present incentive to unduly restrict the number of hydrants be removed.

Another thing I was very glad to hear Mr. French mention was the desirability of not having dual supplies unless there is some special condition. I think this is in the same class with the so-called dual supply for domestic water. That question frequently comes up in this way: "Why is it not wise, instead of having all the water pure, simply to have a small supply of good, pure water for household use, and let the main supply for general uses be as it may?" Outside of the question of danger to health in having a dual supply, where people are always prone to drink from the wrong one, there is the question of the economy of the system. Very seldom it happens that it is economical to build two systems. And I think the same is true as regards fire protection; it is rarely true that it pays to build two different systems, unless the situation is very unusual, like a congested and hazardous section in a large city, and I was glad to hear Mr. French mention this. It is more economical to have a unified and simplified system than to have one that is complicated.

Mr. George A. Stacy.* This discussion as to high service and fire protection is certainly an important subject. When the Marlboro water works were constructed, in 1883, we had a pressure varying from 16 to 142 lb. for our domestic supply and for fire purposes. That condition prevailed for ten years. In the upper levels of the city, where some of our largest factories and buildings were, perhaps a third of them, we had only 30 lb. pressure. Since the public water supply was introduced, we have been dependent upon hydrant pressure entirely for fire protection. Previous to that time we had the old hand engines; we have never had a steamer. As the factories grew in size, and the buildings were more numerous and larger, the insurance companies insisted that we should either have a steamer or improve the pressure on the system. The matter was taken up, and it was finally decided to erect a standpipe with three miles of separate mains to cover the higher levels of the city. That brought the pressure for fight-

* Superintendent of Water Works, Marlboro, Mass.

ing fires up to 60 lb. on the higher levels, and we carried the stand-pipe system to the point where we had 50 lb. pressure at the hydrants from the reservoir. The reservoir is of 5½ million gallons capacity.

Our high-pressure system was designed to deliver ten streams of 250 gallons a minute, with a loss of pressure of from 8 to 10 lb. The system was tested near one of our largest factories, and on a four-way hydrant we put a pressure gage on one nozzle, and we took three streams out of the others, and we took eleven streams in all from the system. When they were all playing, the gage showed a maximum loss of 7½ lb. We used 1⅛-in. nozzles, except one which was 1¼ in.

In the district covered by the stand-pipe system, where we had 30 lb. pressure we now have 80, and that has been sufficient for any work that we have had to do. There is no question but what a gravity system is the ideal system for fire fighting, if the pressure is sufficient; and we feel to-day in Marlboro that we have a system that answers every requirement.

There is something which has not been brought up here, which I know to a certain extent affects the capacity of our mains, as they grow older; and that is the filling up of the mains by tubercles. We had one 4-in. line, about 1 600 ft. long, and a barn took fire out at the end of it; they had to lay about 450 feet of hose The initial pressure was 65 lb., and the result was that they couldn't get a fire stream near enough to that barn to wet it. We replaced this line with 6-in. pipe, and I don't think the 4-in. line had a capacity of a 2-in. pipe. I never saw a pipe so filled up in all my experience.

One 4-in. line that I replaced with a 6-in. pipe, I found perhaps not over 10 per cent. reduced in capacity. I think the amount of tuberculation will vary to a certain extent in different localities and under different conditions.

I believe, as has been said here to-day, and I have always advocated it, that hydrants are a great deal cheaper than hose; and those of you who have been in the fire department, and have had practical knowledge of the work, know that you can get two streams on a fire with 250 or 300 ft. of hose as quickly as you can get one with 500 ft., and there will be higher pressure at the nozzles.

On one of our streets about 700 ft. long and situated on one of the higher levels, where there is only 25 lb. pressure and where there are only two-story houses, well separated and on one side of the street only, we had 150 ft. of hose connected to a hydrant at the end of the street and found that there was pressure enough to send the water clean over the building, the men standing at a place where they would naturally stand if the fire was pretty warm. When, however, we connected 500 ft. of hose, there was not pressure enough for effective work. We put in, therefore, another hydrant 400 ft. from the first, and now there is sufficient pressure and volume to control any fire that would naturally occur there. Wherever it is possible to obtain it at a reasonable expense, I think that the most effective and most satisfactory service is from a direct pressure gravity supply; and I believe that with ample pipe capacity, where such service can be obtained for a reasonable sum, you have the ideal fire service.

Mr. Walter H. Richards.* There is just one point I should like to make, that I think has not been touched upon, — the practical business point of view. The insurance companies come before us and ask us to make these improvements. Who pays for them, who gets paid for the improvements, and who receives the benefit? Is it the people, or is it the insurance companies? I have never heard of a case, when a change has been made of this kind, where the insurance companies have lowered their rates. It seems to me it is up to them to do a little something in that line. If the community pays for these improvements, the community should get the benefit of them. If the insurance companies keep right on charging the same rate, the people don't get any benefit at all, but it simply puts more money into the pockets of the insurance companies. That is all there is to it.

The Manufacturers Mutual has been for years coming before this Association and suggesting these improvements and expenses in addition to the regular expenses of the water-works system, but there is never any lowering of rates on property of the whole community. They come as special pleaders for a special benefit to themselves, and not to the city as a whole. Now, in all improvements of any kind, whether in water-works systems or anything

* Engineer and Superintendent Water and Sewer Department, New London, Conn.

else, we always want to know whether it is going to pay, and it seems to me that these requirements do not pay anybody but the insurance companies.

Mr. Stacy. In regard to hose, we have been fortunate in buying very good hose from way back in the old time when we used leather hose, — and anybody who has had to handle that kind knows what that means, — up to the present. My experience has been that when we have had a large fire we have had the most trouble with hose, and that happens largely for the reason that the old hose is kept on the racks and of course deteriorates to a certain extent from age, whether it is used or not. Now, it may be that the chief has gone to the city government and said, "We want some more hose." The question is asked, "How much hose have you got?" And he replies that they have so much. "Isn't that enough? How much do you ever use?" "But," he says, "some of this hose is getting old." So the committee of the city government goes around and looks at it, and it looks all right to the members of the committee, and it is hard to make them understand, although they are honest enough, the necessity of getting any more. We figured out that a certain amount of hose was needed every year to keep the supply up to the standard, but we couldn't make the powers that be believe that always. Now, when there is a large fire, you pull down your old hose, and just as you get to work, away it goes, and you put in another line, and away that goes, and then everybody is up in arms and says that the department is no good and the whole system is rotten. But we know that the fire department is not to blame. There won't be much trouble if the hose is tested, say, once in every two years and the worthless hose thrown out and enough new purchased to keep the supply up to the standard. The men who are at the head of the thing, who really have the authority to purchase hose, may be honest in their opinion. They see the hose, it looks all right, and that is enough for them. It is just the same as in the case of a hydrant; it looks all right, although there may be three ¾-in. pipes running into it. That doesn't make any difference. The committee don't want to spend any money on it because it looks all right, and they are honest enough in their opinion. A certain per cent. of new hose should be purchased every year, and then it

can be determined pretty close when that hose is going to give out.

MR. BOOTH. I should like to be able to give some assurance to the gentleman who complains that he gets no reduction in his insurance rates, but the National Board has no control over that matter. There is another side to the question, of course, and that is the benefit it is to a merchant or manufacturer to have no fire on his premises, or if one occurs to have it put out quickly. The way the insurance companies look at it is that it is hardly fair to expect them to pay for everything. I see that Mr. Stacy does not agree to that.

MR. STACY. I think there ought to be at least a fair division.

MR. KING. There is one point which Mr. French referred to upon which I would like to know if he can give us any more information. He spoke about the roughening up of the inside of hose. Doesn't that occur with old hose, and isn't it in some respects worse than to have the hose burst, because you are expecting a larger flow through the hose than what you can get because of the roughness of the inside and the greater amount of friction?

MR. FRENCH. *Mr. President,* — what I had reference to was not so much a change in the condition of the hose due to age as the difference in smoothness of lining, depending on how the hose is made. Possibly a word or two may be of interest in that connection. In making rubber-lined hose, the cotton fabric is first finished, and as that is woven, the interior, before the rubber lining is put in, would be rough due to the fact that the yarn used is rather large and that there is a space between each strand. Now, it is possible to back up a rubber lining by a proper packing of soft rubber, so that when you put in the final lining the spaces between the strands are filled up, and it remains smooth. If this is not done properly, if there is a desire to cheapen the hose, the filling up can be omitted and the lining can be simply cemented on the inside, and when you look through it it may look pretty smooth. But when a pressure is put on, say of 100 lb., that forces the rubber lining, which, of course, is very elastic, into the spaces between the strands of the yarn and makes a rough interior.

In order to determine the exact effect of this action, this matter was taken up by Mr. John R. Freeman some years ago. Hose of

various kinds was tested and it was found that in a good grade of hose the loss was about 14 lb. for every 100 ft. of length with a standard stream flowing. With another grade of hose, which was just as easily bought and probably at about the same price, the loss was 25 lb. in 100 ft., nearly twice as much as in the good grade. In order to show this graphically, short lengths of hose were taken, a coupling put on each end, and a cap put on one end and the hose then filled with plaster of Paris.

Before the plaster hardened a cap was put on the other end and the hose subjected to a pressure of from 80 to 100 lb., and the pressure kept on while the plaster was hardening. This forced the lining into the position that it really is in when the hose is carrying water. Then, after the plaster of Paris had hardened, the hose was cut open and the plaster cast removed. Plate V shows two pictures of hose where this was done, — Fig. 1, a very rough interior, judging by the plaster cast, and Fig. 2, a very smooth one.

Now, it is perfectly possible to get a reasonably smooth lining if it is insisted upon, and it is easy enough to test it, either by this method, which is very easily applied, or possibly better by taking several lengths of hose and measuring the friction loss through them, and thus showing the manufacturer right off whether or not he is giving you a lining that is reasonably smooth.

In answer to Mr. King, it is probable that as hose gets older, the lining, which may have been fairly good in the beginning, tends to crack and to get rough. I have not heard that point brought up before, but I see no reason why there shouldn't be some increase in the friction of hose due to this cause. I imagine, however, before that would get to be very bad, before the increase of friction would be really serious, that the hose under pressure would probably give way and leak so that you might have to throw it out.

While we are on the subject of hose, it is unfortunate that hose manufacturers have for fire department hose taken a position that for the present prevents the adoption of the kind of specifications which ought to be adopted. I have no doubt that eventually a broader view will prevail, and all interests will get together on the question. We found many years ago a great deal of very poor hose in the mills, and specifications were made over fifteen years ago for our factory fire hose. These have been pretty well lived

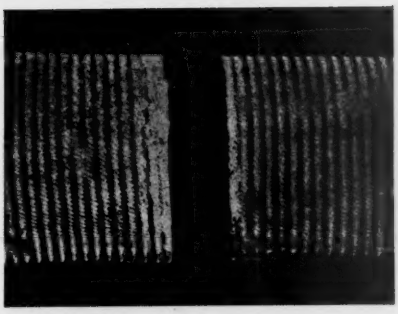


FIG. 1.

PLASTER CAST, SHOWING INTERIOR OF HOSE WITH ROUGH RUBBER LINING.

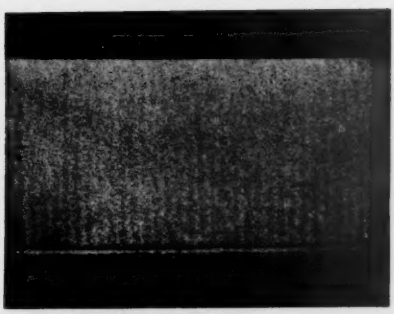


FIG. 2.

PLASTER CAST, SHOWING INTERIOR OF BEST RUBBER-LINED HOSE.

up to, and to-day we get hose in which breaks are quite rare. There is no trouble in making hose so it will stand all the pressure needed, and with rubber linings that will be durable. And right there is one of the most vital questions in hose buying. If the rubber compound is made properly, and the right amount of good rubber put into it, the life of the hose will be from seven to ten years, we will say, while a hose a little bit cheaper in first cost is very likely to go to pieces in three or four years by the cracking up of the rubber lining. It is immensely better economy to pay fifteen or twenty cents, or even more, per foot and get a hose which will last two or three times as long, than it is to buy the cheaper hose and then have to replace it absolutely in two or three years, as well as running the risk of its bursting, as Mr. Stacy says, at the time of a fire. Rubber analysis has got to a point where it is possible to tell what kind of rubber one is getting.

It is a very good plan to test all fire department hose yearly under good pressure, — not a pressure sufficient to damage it, but a pressure sufficient to throw out the poor lengths; and this is really an advantage to the hose because rubber is rather improved by wetting it occasionally. The fabric should be thoroughly dried after the test.

I was interested in what Mr. Richards said about rates of insurance, and I think a word ought to be said about that. I happen to represent insurance interests where, being on the mutual plan, if there is any saving the assured get it, because they get all there is left after paying the losses. Now, it is a fact that it will generally cost seven to ten times as much to insure an unprotected plant as a protected one. The owner does get that benefit, and, what is more, the cost of the protective equipment, which the owner puts in at his own expense and not at the expense of the town or city, is usually all recovered by the mere saving in insurance cost in less than five years. One couldn't get a better investment, because he not only gets his money back, but after it comes back, he saves money very fast in insurance charged; then, what is more important than all that to any prosperous manufacturer, the danger of burning up a business when making money is almost eliminated, and most of our American manufacturers are making money one way or the other most of the time.

I am not acquainted with the general insurance business in cities and towns, our work being confined entirely to manufacturing properties having special protection; but I believe there is not the slightest question but that practically, though one may not be able to figure it instantly, in any case when better fire protection is provided there is a saving in insurance cost. If rates do not immediately go down, they are prevented from going up, because in the long run the only way an insurance company of any kind, whether mutual or stock, gets any money is by collecting it from people. There is no inexhaustible treasure box from which to pay losses, — the money must be collected in one way or another. When property is burnt up it has to be paid for by the people who live in the community, but that community is sometimes spread over a broad area, so that one place helps another. No city in this country can say that it is so much better than some other that it ought not to contribute, for while one place may be paying something out to-day, to-morrow the money may be rolling back to it. Every improvement in fire protection and water supply that reduces fire loss is sure in the long run to mean a saving to the people of the country.

There is another point that Mr. Knowles made that ought to be emphasized. We meet it again and again in connection with automatic sprinklers. To have as a basis of payment for fire protection, when payment is made, a certain price per hydrant or per sprinkler is the best way to discourage good fire protection. You induce a town, when they have to pay so much per hydrant, to try to get along with about half the hydrants that they ought to have. Now the fact is that one hydrant, costing possibly all set $40 or $50, will last for years. If that hydrant saves 200 or 300 ft. of hose at approximately $1 a foot, it saves a good many times the value of the hose that would have to be used. Moreover, hose, even the best quality, will have to be renewed every seven to ten years, while the hydrant will last indefinitely. You can easily make figures which will show that you can save more money by putting in hydrants for the fire department than in any other way, when it means a real saving in the amount of hose that has to be carried. Charging by hydrant or by sprinkler is a direct discouragement of putting in all you ought to have, and really the only

proper basis, as Mr. Knowles has intimated, is to charge for what is really given, that is, for the amount of fire protection that is available. It is hard, however, to measure that. We had a committee of the New England Water Works Association some years ago, and I happened to be a member of it, that tried to get up some method of doing this, but did not succeed in getting anything which was workable. But there must be some way which can be developed, which will be broader and better than the old way, and which will bring a proper return, when a charge is a proper one to make, but still will not discourage the very thing that is desirable to encourage.

Somebody mentioned a trouble we are meeting a good deal, and that is an apparent carelessness in pipe laying, which results in getting stones or gravel in the pipes. We have had some cases where on the opening of a number of automatic sprinklers in a rather severe fire the extra rush of water swept along a lot of rubbish, which evidently had collected in the pipe, probably getting in at the time when the pipe was being laid, and obstructed a number of sprinklers. I have seen repeatedly in mill yards, where we were testing the hydrant system, one after another, $1\frac{1}{2}$-in. nozzle, plugged with stones, and the men would have to shut off the line, unscrew the nozzle, and take the stones out, and sometimes it was necessary to knock them out, they would be wedged in so hard. That is a thing which in some cases has given us a good deal of concern.

Mr. King brought up the question of valve inspection which is a very important matter. In our factory properties, which are all equipped with automatic sprinklers, there are many hundreds of valves, because each riser has to have a valve, and very often, especially in the older plants, there is a valve at each floor. Our inspectors find a good many valves closed, and where so much depends on the automatic sprinklers we have found it necessary to take this matter up specially. In spite of the fact that this point is being watched with the very greatest care, and that those plants are under the supervision of men of a good deal of ability, we find every month that it takes two or three sheets to merely list the closed valves found in factories in the United States and Canada, and give a brief account of the cause of each one. It is

usually the case that the valve was shut for something and forgotten. We have made the suggestion, and many of the mills have agreed to it, that the mill should have a man, very often the master mechanic, or some man under him, generally a member of the factory fire brigade, go around at least once a week and try every valve on the plant. We have gotten up a simple form that gives a place for each valve, and we advise the mill owners to tag each valve, either with a brass tag with a number, or sometimes a number painted on the valve. Then a man takes the list and goes to each valve, and as he notes its condition he checks it up on this list as "open," "shut," or in whatever condition it is in. In some of the larger plants, where the owners are very exact about the thing, they have arranged a system of punching, and a man punches a tag attached to the valve, showing the condition he finds it in, and the dates, and then after awhile those cards go to the manager. This makes it necessary for the man to go to the valve to make his record, but is too elaborate, except for some of the very large plants.

As we test the water in the factory yards once a year, we find every summer a number of valves in city connections or in city streets closed. We find them in this way: Our men are instructed never to touch or to do anything with the public valves without first taking the matter up with the water-works superintendent, so that they can work absolutely together; but we can go into the factory yard, and first notifying the water department, when they ask it, and open up several streams. We may have found last year that four streams drew the pressure, we will say, from 80 lb. to 60 lb., and this year four streams draw it from 80 lb. to 40 lb., which shows right off that there is something wrong. Then the matter is looked up, and again and again a street valve will be found partly or entirely closed.

We had a very glaring case of that in one of our plants, where there were several connections into the mill yard. It was a plant which needed automatic sprinklers very much, being a rather hazardous sort of old construction. Our man in testing got very little water, and in looking up the matter found that there was an obstruction in one of the connections. That was removed and it was supposed that everything was all right, but the mill manager,

not being satisfied, tried another test and got unsatisfactory results. An investigation showed that the trouble was due to the fact that two connections came into the yard fed by one branch from the city main. In that branch was a closed valve, which had been closed, apparently, for some work on the street, though this was in one of the well-managed water-works systems. Now, that mill for several weeks between the visits of our inspectors had a water supply on its automatic sprinkler system sufficient for only a few sprinklers, when it really was a plant which needed a most ample supply. This does show the need, which Mr. King brings up, of looking out for valves in city streets, just as much as watching the factory equipment; and I do not see any reason why it would not be possible to get up a blank on which, possibly, the valves would be numbered, in accordance with a map in the superintendent's office, and perhaps the different sections of the city divided, and then once or twice a year, or as often as necessary, have a man go around and try the valves and check them up. If they are numbered or located in some way he is not so likely to miss a valve as if he is merely told to go out and try all the valves. You don't know whether he tries them all or not, — he himself really doesn't know, although he may think he does, — but if the work is laid out in some systematic way, there will be much less chance of missing a valve. I think that could be done with the very greatest advantage.

Just one point more with regard to hose couplings. I happened to be in Fryeburg, Me., once when a part of the village burned, and the fire was a thrilling sight as it went almost unchecked along the beautiful village street. A steamer came by train from Portland, fifty miles, and when it arrived, several hours after the fire had started, there was the greatest cheering and encouragement. The Portland firemen rushed into the town, pulled their hose wagon along and laid out several lines, and everybody thought that now the fire was going to be extinguished. The steamer went to hydrant, but it couldn't connect. I can see the picture to-day of that steamer standing there in the village street, with all its polished metal work, and the hydrant there, but no means of getting the two together, and the fire going on and on until it finally was checked by the feeble means that the town department had.

While that isn't half as much a story as the story of the Baltimore fire, yet, having seen it, it makes a much more graphic picture for me; and the idea that in this age neighboring communities, which would like to help each other, are prevented from getting together by the fact that a few screw threads won't fit, seems perfectly ridiculous.

MR. COGGESHALL.* Mr. President, I haven't any doubt but what very full instructions are given to all the mill people, as Mr. French says, and that they have a fine plan, with everything set out on it, but, nevertheless, we occasionally have a telephone call to the office asking where such-and-such a gate is, or what such-and-such a gate controls, so I think there is still a chance for a little more missionary work in that line.

MR. FRENCH. There is no doubt about that, but still a good deal is being accomplished, Mr. Coggeshall.

MR. GEO. W. BOOTH (*by letter*). The attached forms were adopted by the New York Department of Water Supply for use on the separate fire main system, after a study of the forms in use in various cities; these forms have proved very satisfactory and it is planned to extend their use to the domestic system as soon as clerical provision is made to take care of it, but as this means 25 000 or 30 000 of both valves and hydrants, it is something of a task to prepare for it.

I have asked for suggested changes to these forms, both from some of our National Board engineers and from the engineers who have used them, the only suggestion being a widening of some of the columns on the "Valve Record" sheet.

Each valve and each hydrant should have a number, and these numbers and the general location of the valve should be shown on key maps. The detailed locations may be shown either by sketches on small sheets, with ties to fixed objects, or in tabular form, with reference distances either to curb lines or to street lines. It is believed that the latter method is preferable where curb or property lines are well defined.

The "Field Report" sheet is to be turned in each day by the foreman in charge of each gang, and to show a complete record of operations of any kind. A "Valve Record" sheet is provided

*Superintendent of Water Works, New Bedford, Mass.

for each valve in service and is kept in the office and filled out up to date from the field reports turned in by the foreman.

It may be that local conditions will call for some changes in the form, but the general idea appears to be satisfactory.

FIELD REPORT.

No.....
(To be filled in at Main Office)

Station Blotter No...... **Station**..... **Date**.....

Work Done .....

.....

.....

.....

Line Shut Down from.....o'clock.....19.....to.....o'clock.....19.....

List of Gates and Hydrants Disturbed or Other Work Done.

Size or Type of Valve or Hydrant.	Location.	Repairs, Etc.	Condition in which left.

Date..... VALVE RECORD Record Number.....

Location of valve .....

On.....inch main in.....Street.....

Description (upright, on side, geared, ungeared).....

.....inch valve.....screw.....turns to open full. Opens right left. Screw extends when closed.....inch

.....inch bye pass.....screw.....turns to open full. Opens right left. Screw extends when closed.....inch

Distance from operating nut to street surface.....Valve set in .....Type of cover.....

Made by.....Date made.....Date set.....

Field Report No.	Shut Down	Opened	Reported Out of Order	Reported Poor Condition	Reported Good Condition	Foreman

PROCEEDINGS.

SPECIAL MEETING.

HOTEL KIMBALL,
SPRINGFIELD, MASS., April 12, 1911.

Mr. Allen Hazen, President, in the chair.
The following members and guests were present:

MEMBERS.

S. A. Agnew, G. W. Batchelder, J. F. Bigelow, C. A. Bogardus, I. W. Brooks, Edmund Brown, G. A. P. Buckman, T. J. Carmody, R. C. P. Coggeshall, M. F. Collins, H. R. Cooper, F. H. Crandall, G. E. Crowell, J. A. Fitch, E. V. French, Albert S. Glover, R. K. Hale, F. E. Hall, C. N. Harrub, A. R. Hathaway, Allen Hazen, F. T. Kemble, Willard Kent, A. C. King, G. A. King, H. M. King, J. J. Kirkpatrick, Morris Knowles, E. E. Lochridge, Daniel MacDonald, S. H. McKenzie, W. A. McKenzie, Hugh McLean, A. E. Martin, W. E. Maybury, G. F. Merrill, H. A. Miller, O. E. Parks, E. M. Peck, A. E. Pickup, W. H. Richards, Henry Roberts, H. W. Sanderson, J. E. Sheldon, A. F. Sickman, G. A. Stacy, L. A. Taylor, J. L. Tighe, J. H. Walsh, F. N. Northrop. — 50.

ASSOCIATES.

Anderson Coupling Company, by Charles E. Pratt; Chadwick-Boston Lead Company, by A. H. Brodrick; Chapman Valve Manufacturing Company, by H. L. DeWolf, V. N. Bengle, H. D. Storrs, Robert Shirley; Darling Pump and Manufacturing Company, by H. H. Davis; Hersey Manufacturing Company, by Albert S. Glover; Henry R. Worthington, by Samuel Harrison; Fred A. Houdlette & Son, Inc., by M. S. Kahurl; Lead Lined Iron Pipe Company, by T. E. Dwyer; Ludlow Valve Manufacturing Company, Arthur R. Taylor; Charles Millar & Son Company, C. F. Glavin; National Meter Company, by J. G. Lufkin; Neptune Meter Company, by H. H. Kinsey; Pittsburg Meter Company, by F. N. Northrop; A. P. Smith Manufacturing Company, by F. N. Whitcomb; Thomson Meter Company, by E. M. Shedd; Union Water Meter Company, by F. E. Hall. — 19.

GUESTS.

James P. Steele, C. A. Cooke, Marlboro, Mass.; E. C. Colters, S. A. Allen, and John L. Hyde, Westfield, Mass.; C. L. McNeil, Torrington, Conn.; T. J. Lynch, T. J. McCarthy, Hon. John J. White, mayor, of Holyoke, Mass.;

H. E. Bodurtha, Agawam, Mass.; T. A. Collins, Boston, Mass.; Wm. J. Trevithick, Middletown, Conn.; C. A. Goodhue, Thompsonville, Conn.; Edward H. Lathrop, mayor of Springfield, Wm. H. Daggett, C. M. Waterbury, A. L. Fletcher, H. M. Lee, C. A. Crocker, S. L. Haynes, I. B. Hinkley, Thomas Greeley, Frank L. Worthy, Springfield, Mass.; C. M. Woodward, W. H. Sanburn, West Springfield, Mass.; G. W. Booth, F. M. Griswold, New York City; C. C. Dyer, Wm. F. Aiken, Thomas L. Lawler, Greenfield, Mass.; Dr. P. L. Brown, G. F. Farmer, and James J. Fitzgerald, Springfield, Mass. — 33.

THE PRESIDENT. Gentlemen, all things come to Springfield sooner or later. A few weeks ago, when some of the Tech Alumni of Springfield got together and offered a site for the Massachusetts Institute of Technology, if it would come to Springfield, because there appeared to be great difficulty in getting a suitable site in Boston, I remember seeing a cartoon in the Boston *Globe* representing Springfield as trying to pull away the Institute of Technology and Boston trying to fasten down Bunker Hill Monument and Faneuil Hall so that those could not be taken. When our Springfield friends asked the New England Water Works Association to come here, however, I don't think any of us wanted to nail the Association down to Boston, we were all glad to come. I have the pleasure now of introducing to you Mayor Lathrop.

MAYOR LATHROP. This introduction has been a little bit sudden. I was lying back luxuriating in the expectation of hearing a formal speech, out of which I could acquire at least a bit of watery education. I didn't suppose that your friend, the President, was to terminate his address so quickly. I never apologize for being present most anywhere. But let me tell you in confidence that my being here is a sort of conspiracy between my engineer and my associate water commissioners, who know something, and inasmuch as they, in the various performances of our municipal functions, help me over places where I need assistance, there is no reason in the world why I shouldn't obey their summons whenever and wherever it comes. These public functions that are incident to the office of mayor are not generally observed in the daytime. Most always our public functions are nocturnal, and in a measure it is safer than when we perform them in the daylight; but inasmuch as water is the pervasive element in your profession,

as also the dominating liquid of the feast, I find that this occasion is absolutely safe.

There is no occasion for extending a formal welcome to you gentlemen here. Before coming I was a little bit doubtful as to any peculiar capacity I might have in the line of extending a welcome to you in a proper way, and I have not been able to get any special inspiration in the way of information with reference to your professional accomplishments or really as to the scope of your endeavors and the definite results that you are illustrating so vividly and so practically throughout the municipalities not only of the Commonwealth but of the country. We have been suffering from hard lines within the last two years, and I don't know but it is attributable to the fact that you people didn't come here earlier. We haven't had water enough, until within the last few months, notwithstanding that we have been in the habit of making pretty large municipal boasts with reference to our accomplishments and our quantities in the way of a water supply. Now, however, by reason of a fortunate combination, perhaps, of the elements, we are getting to a position where our engineer can with propriety boast of the capacity of the reservoir and assure an anxious people that there will be water enough — except that we can't let our neighboring municipalities have any.

You know that we have a number of suburban neighbors who have a habit of clamoring quite largely and vociferously when they want anything badly. They have got the most peculiar habit of hollering for water, instead of the other thing, and we have got in the way of being a little careless when that demand comes at our backdoors. So we sit by in a sort of self-congratulatory condition that we can inundate ourselves when we desire it, and if we are a bit malicious in our enjoyment, we can say, "Good people, why didn't you get into gear earlier? That is what we did, and now you see what our results are." We can say to them, "If you suffer for water now, just think what the ultimate consequences may be, when you enter upon a more extended existence."

However, levity aside, gentlemen, this is not my opportunity, nor is it my intention to occupy much of your time. I think I interpret most correctly and thoroughly the sentiment of the

people of this municipality in saying to you that not only is the city pleased at your attendance here, but that we have a sort of a grateful feeling that runs towards a bit of benediction that your coming here is a sort of an assurance that whenever we need help, if we want water, we shall know where our ultimate resort is. We have superintendents, engineers, and commissioners. Some of the commissioners don't know much, — I am one of them, — but I am buttressed so well by my associates that I am at least a little bit entitled to brag on such an occasion as this for their benefit. So I say that when we ever get *in extremis*, we shall know the sources of resort when we want our relief, because if our own instrumentalities fail we can reach out to you and say "For the Lord's sake come and help us and keep us out of the condition that Long Meadow and West Springfield are already in." Now, let me say to you, gentlemen, notwithstanding that this is a daylight excursion, which is a little bit unnatural, especially when we eat and drink, I, in the name of the municipality, bring you the largest possible and the warmest welcome. [*Applause.*]

THE PRESIDENT. We thank you, Mr. Mayor, and it gives me special pleasure to hear you speak about some things that I have been saying to you in regard to selling water. You see, gentlemen, I have been telling the mayor that he now, having a good water supply and plenty of it, might fairly divide with some of his neighbors who need it, the only proviso being that he shall get good value for everything that he sells. He has been a little worried for fear that he might sell too much of it, but I have told him not to worry about that, but to go ahead and sell all he can.

THE MAYOR. Whether we can deliver it or not?

THE PRESIDENT. That is just the point, for some of us here know how to build works, and we can build him all the works that he needs, so that he can sell all the water he wants to.

The subject of our meeting to-day is fire protection, and that brings to mind that some years ago, when the new water supply for Springfield was being talked about, there were two fires here happening very close together, one the City Hall and the other the church on the hill, in which two lives were lost; and those

fires had a good deal to do with pushing forward the adoption of a new source of supply which has since been constructed. Springfield has been growing rapidly and is being built well. If every one would build as good buildings as this hotel, which I have seen to-day for the first time, there wouldn't be as much need for large quantities of water for fire protection as there now is. The day is coming when substantial construction of this kind will take the place very largely in our cities of the more flimsy and inflammable construction of the past, and the fire protection requirements in the future I look forward confidently to as being on a very different basis from those of the present time. But at the present time we have our cities built up as they are, and urgently need more adequate fire protection against the dreadful disasters of which we have too many examples. We are favored to-day in having with us Mr. French, a man who has had a great deal to do with the development of the insurance end of this work; and one of the most impressive facts of that work is that the insurance people have learned how to prevent fires. It seems to me that their work in preventing fires has come to be, perhaps, from the standpoint of the community, much more important than what was, I suppose, the original idea of compensating people for loss by fire.

Mr. E. V. French, vice-president and engineer of the Arkwright Mutual Fire Insurance Company, of Boston, then presented a paper on "Desirable Pressure at Hydrants." He was followed by Mr. George W. Booth, who is connected with the National Board of Fire Underwriters. Mr. F. M. Griswold spoke about the National Standard Hose Coupling. Mr. R. C. P. Coggeshall read an extract from a letter from his son, who is located in business in Yokohama, Japan, giving a description of a fire there and the way it was handled by the Japanese fire department. Among others who spoke were Messrs. George A. King, Morris Knowles, Walter H. Richards, and George A. Stacy.

The Secretary presented application for membership, duly recommended and endorsed, from George W. Booth, East Orange N. J., with National Board of Fire Underwriters, New York City; Thomas Fleming, Jr., Pittsburg, Pa., hydraulic and sanitary engineer, Pennsylvania State Department of Health; Joseph H.

White, Birmingham, Ala., Construction Department, Tennessee Coal, Iron and Railroad Company; Thomas J. Lynch, Holyoke, Mass., treasurer Holyoke Water Board; F. M. Heermann, Dorchester, Mass., engineer and special inspector for the Associated Factory Mutual Fire Insurance Companies; Henry Pike Letton, Lincoln, Neb., civil engineer, at present taking special graduate work in sanitary engineering at Massachusetts Institute of Technology; Alton D. Adams, Worcester, Mass., constructor of electric plants and appraiser of water powers.

On motion of Mr. A. E. Martin, the Secretary was directed to cast one ballot in favor of the admission of the applicants, and, he having done so, they were declared duly elected members of the Association.

Adjourned.

EXECUTIVE COMMITTEE.

Meeting of the Executive Committee of the New England Water Works Association at Hotel Kimball, Springfield, Mass., at twelve o'clock, Wednesday, April 12, 1911.

President: President Allen Hazen, and members Michael F. Collins, Morris Knowles, William E. Maybury, John J. Kirkpatrick, Richard K. Hale, and Willard Kent.

Several applications were received and recommended for admission, namely: For membership, Alton D. Adams, lawyer and consulting engineer, Worcester, Mass.; Harry P. Letton, sanitary engineer, Lincoln, Neb.; F. M. Heermann, engineer and special inspector, Associated Factory Mutual Fire Insurance Companies, Boston, Mass.; Thomas J. Lynch, treasurer Holyoke Water Works, Holyoke, Mass.; Thomas Fleming, Jr., consulting engineer, Pittsburg, Pa.; George W. Booth, chief engineer, Committee on Fire Protection, National Board of Fire Underwriters, New York City; Joseph H. White, Construction Department, Tennessee Coal, Iron and Railroad Company, Birmingham, Ala.

Voted: That the Secretary be and hereby is authorized to dispose of copies of papers to members, at his discretion, at fifty per cent. discount from the established price.

Voted: On motion of Mr. Hale, that the Pittsburg Metal Products Company be authorized to reprint Mr. Kuichling's paper on "Steel Pipe for Water Works," on giving proper credit to the New England Water Works Association.

Adjourned.

WILLARD KENT, *Secretary.*

INDEX OF ADVERTISERS.

	PAGE.
Ashton Valve Co.	xv
Bond, Harold L. & Co.	xi
Boston Engineers' Supply Co.	xii
Buffalo Meter Co.	xiv
Builders Iron Foundry	xxiii
Cancos M'f'g Co.	xii
Chadwick-Boston Lead Co.	xxiv
Chapman Valve M'f'g Co.	xviii
Clark, H. W. Co.	xii
Coffin Valve Co.	xvii
Conrad, Wm. R.	xii
Cook Well Co.	xxix
Dixon, Jos. Crucible Co.	xii
Donaldson Iron Co.	xxi
Eagle Oil and Supply Co.	xxv
Engineering News, The	xxvi
Engineering Record, The	xxviii
Fox, John & Co.	xiii
Hays M'f'g Co.	xxvii
Hersey M'f'g Co.	iv
Lead Lined Iron Pipe Co.	xiii
Leadite Co.	xxx
Ludlow Valve M'f'g Co.	xvii
McWane Pipe Works	xxi
Millar, Chas. & Sons Co.	xv
Mueller, H. M'f'g Co.	x
National Meter Co.	ii, iii
National Water Main Cleaning Co.	xx
Neptune Meter Co.	vi
New York Continental Jewell Filtration Co.	ix
Norwood Engineering Co.	xv
Pitometer Company	xii
Pittsburg Meter Co.	vii
Rensselaer M'f'g Co.	xix
Ross Valve M'f'g Co.	xv
Semet-Solvay Co.	xx
Simplex Valve & Meter Co.	xi
Smith, The A. P. M'f'g Co.	xiii
Smith, B. F. & Co.	xi
Standard Cast Iron Pipe & Foundry Co.	xxix
Thomson Meter Co.	v
Union Water Meter Co.	ix
U. S. Cast Iron Pipe and Foundry Co.	xxii
Warren Foundry and Machine Co.	xix
Wood, R. D. & Co.	xvi
Worthington, Henry R.	viii

CLASSIFIED DIRECTORY OF ADVERTISEMENTS.

	PAGE.
ARTESIAN AND DRIVEN WELLS.	
Cook Well Co.	xxix
B. F. Smith & Co.	xi
BRASS GOODS.	
Hays M'f'g Co.	xxvii
H. Mueller Mfg. Co.	x
H. W. Clark Co.	xii
The A. P. Smith M'f'g Co.	xiii
Union Water Meter Co.	ix
CAST IRON PIPE AND SPECIALS.	
Builders Iron Foundry	xxiii
Donaldson Iron Co.	xxi
John Fox & Co.	xiii
McWane Pipe Works	xxi
Chas. Millar & Sons Co.	xv
Standard Cast Iron Pipe & Foundry Co.	xxix
U. S. Cast Iron Pipe and Foundry Co.	xxii
Warren Foundry and Machine Co.	xix
R. D. Wood & Co.	xvi
CLEANING WATER MAINS.	
National Water Main Cleaning Co.	xx

(Index continued on page xxxi.)

Water Meters

FOR ALL WATER WORKS SERVICE

All Sizes, 5-8 to 60 inches

CROWN
EMPIRE
NASH
GEM
PREMIER

With the only reliable straight-reading register in the market

National Meter Company

84-86 CHAMBERS STREET
NEW YORK CITY

BOSTON	CHICAGO	PITTSBURG	LOS ANGELES
159 Franklin St.	1223 Wabash Ave.	4 Smithfield St.	411 So. Main St.

The NASH
GAS ENGINE and TRIPLEX PUMP

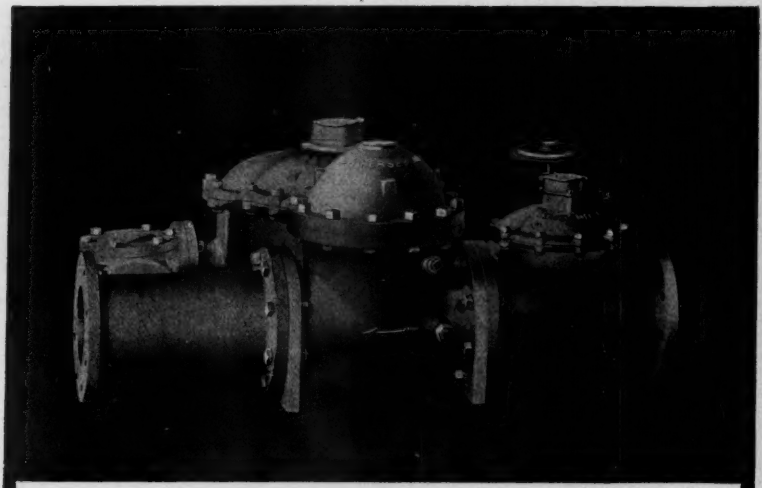
FOR

Town and Village Water Works and Pumping Service Generally

CAN BE ADAPTED FOR EITHER GAS OR GASOLENE

National Meter Company
84-86 CHAMBERS STREET, NEW YORK

CHICAGO: 1223 Wabash Ave. PITTSBURG: 4 Smithfield Street
BOSTON: 159 Franklin Street LONDON: Saracen Chambers
LOS ANGELES: 411 South Main Street



Stop Wholesale Loss

USE THE HERSEY DETECTOR-METER ON FIRE AND MANUFACTURING SERVICES

ENDORSED BY WATER DEPARTMENTS AND UNDERWRITERS

THIS IS THE ONLY METER

WHICH REGISTERS ALL LARGE FLOWS
WHICH REGISTERS ALL SMALL FLOWS
WHICH DOES NOT OBSTRUCT THE FLOW

Send for Catalog and also "THE HERSEY DETECTOR-METER and what Waterwork Officials say about it"

HERSEY MANUFACTURING CO.

Main Office and Works: SOUTH BOSTON, MASS.

BOSTON, MASS., 714 Tremont Temple
CHICAGO, ILL., 84 La Salle Street
COLUMBUS, O., 211 Schultz Building
NEW YORK, N. Y., 174 Fulton Street
BUFFALO, N. Y., 806 White Building
ATLANTA, GA., 201 Kaiser Building

"ALL KINDS OF METERS FOR ALL KINDS OF SERVICES"

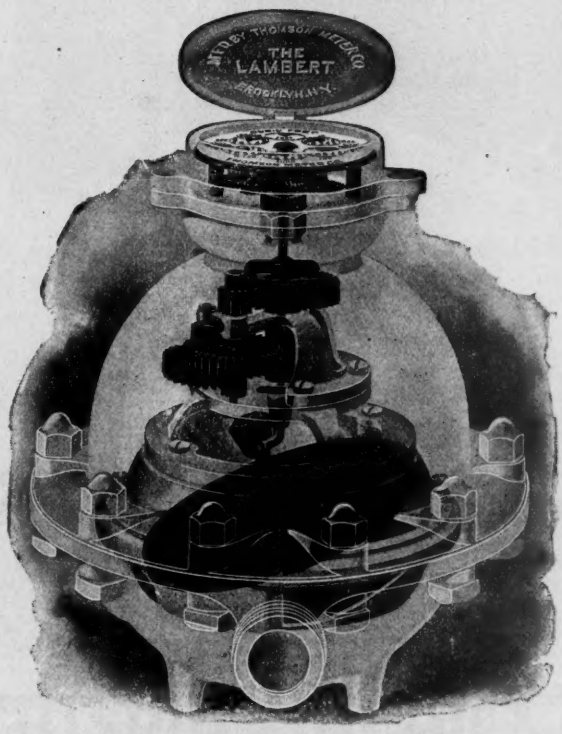
400,000 SOLD

ACCURACY, LONG LIFE,

Avoidance of Repairs

Are the Requisites of the Perfect Water Meter and are the Principal Features of the

"LAMBERT."



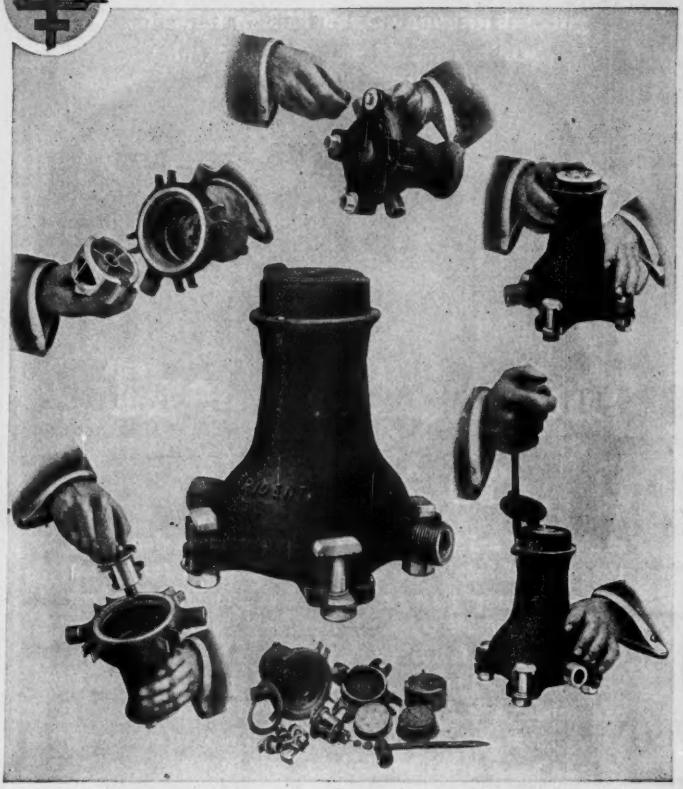
Our unbreakable disk-piston, reinforced with an internal steel plate, can be found only in the **LAMBERT METER.**

The growing popularity of the water-meter system is attributed by many to the inherent excellence of the **"LAMBERT"** meter. Where **"LAMBERT"** meters are selected, success is assured.

THOMSON METER CO.

100-110 BRIDGE ST.
BROOKLYN, N. Y.

TRIDENT WATER METERS



Assembling Simplicity of Trident Construction

The above cut shows a Trident-Disk Meter dismantled and the extreme ease with which it can be assembled, by first putting in the gear train, then the disk-chamber, the frost bottom next, then the register and register box and the meter is complete. The Trident combination wrench is the only tool necessary to use.

NEPTUNE METER COMPANY

90 WEST STREET NEW YORK

CHICAGO, BOSTON, SANFRANCISCO,
ATLANTA, LOSANGELES, PORTLAND, SEATTLE

Satisfactory
WATER METERS

"KEYSTONE"
For house, factory and similar service

"EUREKA"
For large, rapidly flowing volumes

Their excellent service in more than 3,000 cities and towns all over the world speaks for their accuracy, durability and other qualities.

Write for Catalogue 108

Pittsburg Meter Co.

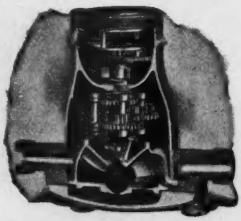
General Offices and Works
EAST PITTSBURG, PA.

NEW YORK 149 Broadway
CHICAGO 337 W. Madison St.
KANSAS CITY 6 W. 10th St.
COLUMBIA, S. C. 1230 Washington St.
SEATTLE 8th & Madison Sts.
SAN FRANCISCO 149 New Montgomery St.

MANUFACTURERS OF WATER METERS AND GAS METERS, ALSO POSITIVE AND PROPORTIONAL GAS METERS FOR ANY PRESSURE

We Send Trial Meters Free

To Cities and Water Companies desiring to Improve their Meter Service



The Worthington Disc Meter

Is not only accurate and well constructed, but it is made in the largest meter factory in the world and by the most modern machinery, and embodies twenty years of experience. The disc is water balanced, reducing wear to a minimum. Sand cannot collect under its bearing and grind it out. Friction is further minimized by the greater displacement per rotation of the disc, which also reduces the speed and wear of the gear train. Drop us a letter giving the conditions of your service and the number of consumers connected, and we will be pleased to send our Bulletin W 112 NE and carry out the conditions of the above offer of a trial meter.

HENRY R. WORTHINGTON

115 Broadway **New York**

208

UNION ROTARY, COLUMBIA, DISC and NILO (Velocity) WATER METERS

Water Pressure Regulators
Waste Stops and Corporations

UNION WATER METER COMPANY
WORCESTER, MASSACHUSETTS

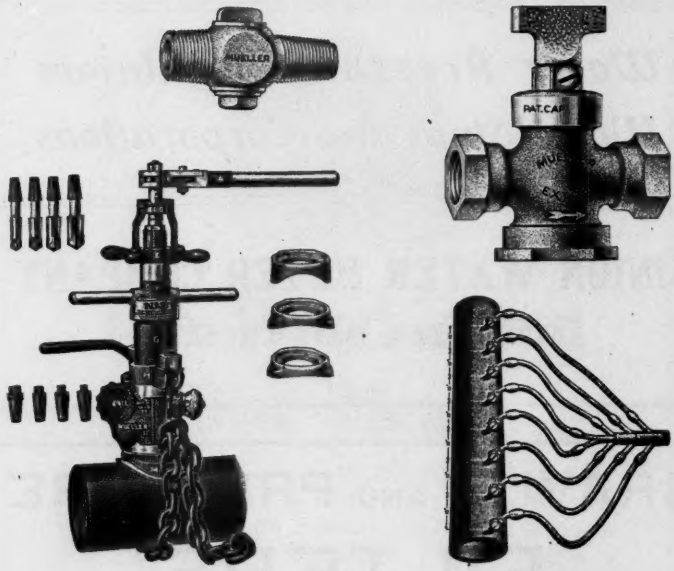
GRAVITY AND PRESSURE
FILTERS

THE NEW YORK CONTINENTAL JEWELL FILTRATION CO.
15 BROAD STREET NEW YORK
167 DEARBORN STREET CHICAGO

OWNERS OF THE NEGATIVE HEAD FILTER PATENT

Licensees:
PITTSBURGH FILTER MFG. CO.
NORWOOD ENGINEERING CO.
ROBERTS FILTER MFG. CO.
J. N. CHESTER, C. E.

Friends That Never Fail You



MUELLER UNCONDITIONALLY GUARANTEED WATER WORKS GOODS are friends that every user appreciates — they are friends that never fail you.

Their record is one of enduring and satisfactory service.

We would be pleased to quote you on tapping machines, corporation cocks (regular or lead flange), goose necks (wipe joint or lead flange), curb cocks, any pattern, branch connections, water meter testers, tools, or in fact anything in the water-works line.

TRADE MARK
MUELLER
REGISTERED

H. MUELLER MFG. CO.

Works and General Offices
DECATUR, ILL., U. S. A.
West Cerro Gordo St.

Eastern Division
NEW YORK, N. Y., U. S. A.
254 Canal St., Cor. Lafayette

C. D. Kirkpatrick, Mgr. S. P. Gates, Asst. Mgr.
Established 1878

B. F. SMITH & CO.
Incorporated

Artesian and Driven Wells, Foundation Borings

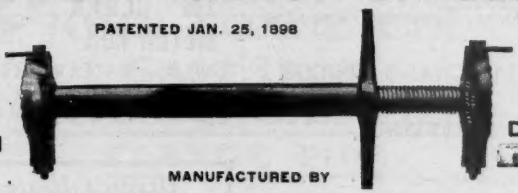
Engineers and Contractors for Municipal and Private Water Works

Office 38 Oliver Street **Boston, Mass.**

SAFETY TRENCH BRACES

PATENTED JAN. 25, 1898

FOR ALL KINDS OF TRENCH WORK



THEY SAVE DAMAGE SUITS

MANUFACTURED BY

HAROLD L. BOND COMPANY

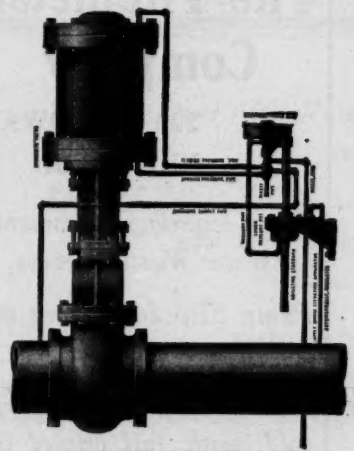
383-391 ATLANTIC AVE. BOSTON, MASS.

ALSO DEALERS IN SUPPLIES FOR

JUTE PACKING WATER WORKS CONSTRUCTION CALKING TOOLS
PIPE JOINTERS LEAD FURNACES

SIMPLEX VALVE AND METER COMPANY

Manufacturers of



REGULATING VALVE

METERS
For Large Pipes

ALTITUDE VALVES
For Reservoirs and Standpipes — Non-Freezable

ALTITUDE VALVES
For Railroad Water Tubs—No Water Hammer

RATE CONTROLLERS
For Filters

Loss of HEAD and Rate of FLOW GAUGES

VENTURI TUBES and MANOMETERS

AUTOMATIC AIR VALVES

112 North Broad St. :: *Philadelphia*

HENRY M. CLARK.

Boston Engineers' Supply Co.,

RUBBER HOSE, BELTING and PACKING

OILS and MILL SUPPLIES,

Engine Packings, Grease and Specialties.

No. 56 PURCHASE STREET,

BOSTON.

TELEPHONE, MAIN 4455-2.

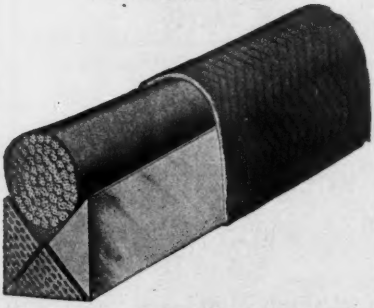
PARAMOUNT CYLINDER OILS.

THIS IS THE FAMOUS

BLACK SQUADRON

METALLIC

PACKING



That is used exclusively in so many of the largest and most up-to-date water-works pumping stations throughout the world.

Send for free samples of high-pressure, low-pressure and semi-metallic. Also send for sample of Cancos Metal Polish.

CANCOS MANUFACTURING CO.

GEO. M. COSTELLO, PREST.

PHILADELPHIA, PA.

Branch Office: 102 HIGH STREET, BOSTON, MASS.

WILLIAM R. CONARD

Assoc. Amer. Soc. C. E. Assoc. Mem. Amer. Soc. M. E.

322 High St., Burlington, N. J.

Inspections and Tests of Materials

SOUTHERN OFFICE

Maison Blanche Bldg., New Orleans, La.

R. C. HUSTON, C.E., Special Representative

H. W. Clark Co.

110 So. 17TH ST.

MATTOON,

ILLINOIS

Manufacturers of

The "CLARK METER BOX"

And other WATER WORKS APPLIANCES

Be sure you have our Catalogue and Prices before buying.

WE CAUTION our many friends and patrons against infringements of our patents.

Dixon's Waterproof

GRAPHITE GREASE

For the lubrication of hydrants, gates, etc.

Send for free sample

JOSEPH DIXON CRUCIBLE CO.

JERSEY CITY, N. J.

The Pitometer Company

220 BROADWAY

NEW YORK

Photo-recording instruments for Water Waste Surveys.

Pump Slip Indicators installed at small cost.

Portable Test Pitometers sold with full printed instructions and tables.

Write for Information

THE A. P. SMITH MANUFACTURING CO.

NEWARK, N. J.

Manufacturers of

Tapping Machines, Fire Hydrants, Water Gates,
Economic Lead Furnaces,
Corporation and Curb Cocks, Brass and Aluminum Castings.
Also General Supplies for Water and Gas Works.

Write for Catalogue.

JOHN FOX NICHOLAS ENGEL

JOHN FOX & CO.

CAST IRON
WATER & GAS PIPES
FLANGE PIPE

Special Castings, Fire Hydrants, Valves
General Foundry and Machine Work
253 BROADWAY - - NEW YORK CITY
Postal Telegraph Building

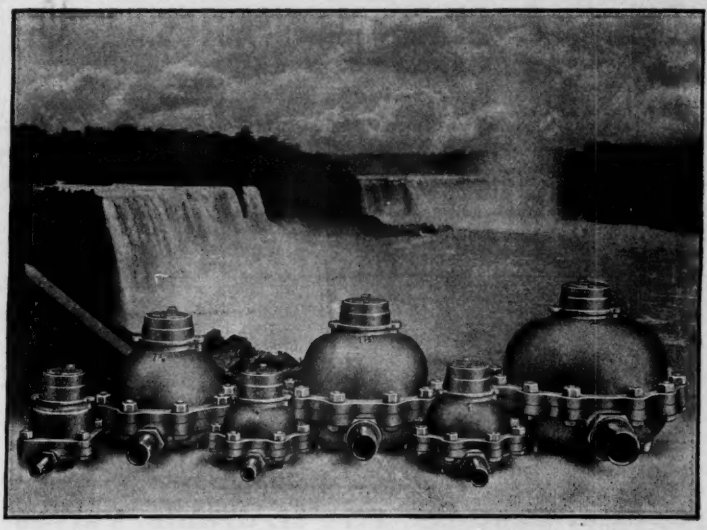
HIGHEST AWARD, GOLD MEDAL,
ST. LOUIS EXPOSITION, 1904

Over 100 Water Departments
use
LEAD-LINED IRON and TIN-LINED PIPES
for their service connections

MANUFACTURED BY

Lead Lined Iron Pipe Company

Wakefield ═══ Mass.



AMERICAN AND NIAGARA WATER METERS

WITH

JEWEL BEARING INTERMEDIATE GEARS

STANDARD DIAL

have one model of high-grade working parts furnished in differently constructed outside casings and fitted with either style of dial. Each meter is assembled and tested with unusual care and precision. Their design, materials and workmanship insure accuracy, durability and satisfaction.

STRAIGHT READING DIAL

BUFFALO METER CO.

290-296 TERRACE, BUFFALO, N. Y.

ESTABLISHED 1892

DISTRIBUTERS FOR NEW ENGLAND

GEO. E. GILCHRIST CO., 106 HIGH STREET, BOSTON, MASS.

WATER
FILTERS
REGULATORS
& ENGINES

We make **Pressure Regulating Valves** for all purposes, steam or water.

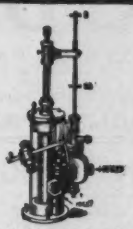
Our **Feed-Water Filter** will keep oil out of your boiler.

We can interest you if you use a condenser.

Water Engines for Pumping Organs

THE ROSS VALVE MFG. CO.

TROY, N. Y.



Standard for pumping church or parlor organs. Ask your organ builder for it or write us.

NORWOOD ENGINEERING CO.

FLORENCE, MASS.

MANUFACTURERS OF

"IMPROVED" WALKER FIRE HYDRANTS

ALSO THE OLD RELIABLE

"Holyoke" Gate Hydrant

LICENSED MANUFACTURERS OF

The Vivian Rate Controller

WRITE FOR CIRCULARS

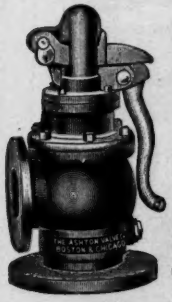
CAST IRON PIPE

FOR WATER AND GAS

CHAS. MILLAR & SON CO., Selling Agents

Main Office, Utica, N. Y.

Branch Office - - - 176 Federal St., Boston, Mass.



They set the Pace

ASHTON POP VALVES and... STEAM GAGES

Superior in Quality of material and workmanship, and with greatest efficiency and durability, they challenge comparison with any others on the market. Send a trial order subject to approval ONLY IF SATISFACTORY, and thereby prove the claims made for them. HIGH GRADE GOODS OUR EXCLUSIVE SPECIALTY.

The ASHTON VALVE CO., 271 Franklin Street, BOSTON, MASS.

S.D. M. I.

R. D. WOOD & CO.

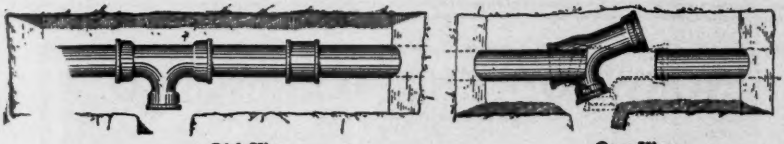
400 CHESTNUT STREET, PHILADELPHIA, PA.

Engineers, Iron Founders and Machinists

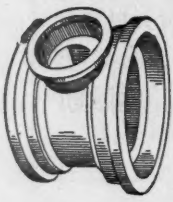
CENTRIFUGAL PUMPS
PUMPING ENGINES

Cast Iron Pipe

CUTTING-IN TEES



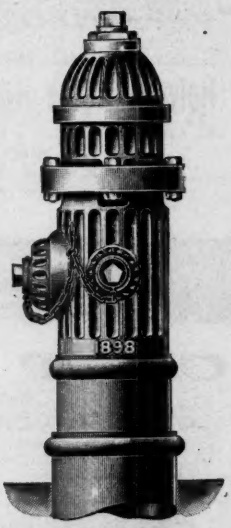
Old Way *Our Way*



Connections economically and easily made with one fitting. Saves sleeve, cuts, lead and unnecessary work and material.

"Reduced Specials"

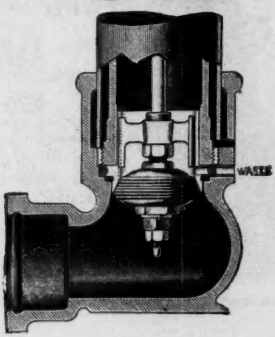
Cost of fittings reduced from 25% to 50%. Full strength. Deep bells. Convenient to handle. Sold by the piece.



Mathews Fire Hydrants

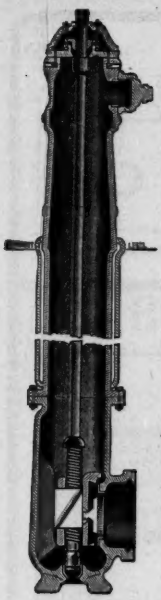
A half century of use has established their reputation as being the most economical, durable and simple hydrant.

Number in use exceeds total of all other makes combined.



Gate Valves

R. D. WOOD & CO. STANDARD
DOUBLE DISK
ANTI-FRICTION
EXTRA WEIGHT, FINISH
AND MATERIAL



THE LUDLOW VALVE MFG. CO.

...MANUFACTURERS OF...

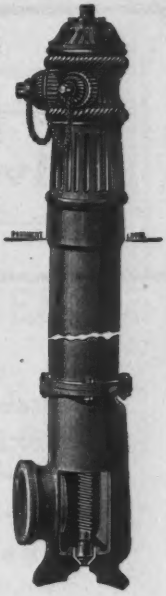
VALVES AND FIRE HYDRANTS

This hydrant is anti-freezing, because when the drainage is good no water is left in it to freeze.
The drip is directly in the bottom of the hydrant and drains perfectly. It is protected by its valve, which never leaves its socket and cannot be clogged.

DOUBLE AND SINGLE GATE VALVES,
ALSO CHECK VALVES,
FOOT VALVES.

FIRE HYDRANTS.

YARD, WASH, AND FLUSH HYDRANTS.



SEND FOR CIRCULARS.

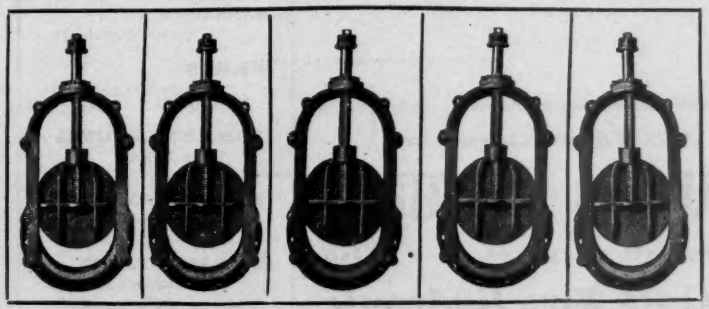
OFFICE AND WORKS: FOOT OF ADAMS STREET, TROY, N. Y.

S. D. M. J.

Coffin Valve Company,

Boston, Mass.

Makers of the largest Sluice and Gate Valves in America



SLUICE VALVES

of every size and for every condition

GATE VALVES CHECK VALVES FIRE HYDRANTS

CHAPMAN
Valve Manufacturing Co.

General Office *and* Works

Indian Orchard Massachusetts

Manufacturers of

Valves and Gates

for all purposes Also

Gate Fire Hydrants

AGENCIES

BOSTON
94 Pearl St.

NEW YORK
49 John St.

PHILADELPHIA
1011 Filbert St.

CHICAGO
120 Franklin St.

ST. LOUIS
16 S. Twelfth St.

CHARLOTTE, N.C.
Thos. B. Whitted & Co.

PITTSBURGH
47 Terminal Way

LONDON
147 Queen Victoria St.

PARIS
54 Boulevard du Temple

JOHANNESBURG
South Africa

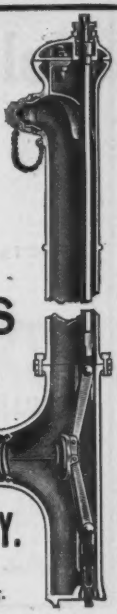
MONTREAL, CAN.
Jas. Robertson Co., Ltd.

TURIN, ITALY
Pietro Ferrero & C.

The "COREY" FIRE HYDRANT

MODERN
SUCCESSFUL
SIMPLE
DURABLE

SUPERIOR



RENSSELAER VALVES

ALL SIZES ALL PRESSURES

WATER, STEAM, GAS, OIL, ETC.

ELECTRICALLY OPERATED VALVES
Check Valves Air Valves
Indicator Posts Valve Boxes

CATALOGUE UPON APPLICATION

RENSSELAER MFG. CO., Troy, N. Y.

BRANCHES

NEW YORK, 180 Broadway
CHICAGO, 1108-9 Monadnock Block
PITTSBURG, 1102 House Bldg.
ST. LOUIS, MO., Room 1228, Chemical Bldg.

Warren Foundry AND Machine Co.

Established 1856

Works at Phillipsburg, New Jersey. .....

Sales Office, 111 Broadway, New York.

Cast Iron Water and Gas **PIPE** From 3 to 60 inches in diameter.

ALSO

ALL SIZES OF FLANGED PIPE

AND SPECIAL CASTINGS.

Solvay Protective Paints

FOR

IRON AND STEEL

CRYSOLITE

PROTECTS CORRUGATED IRON and STRUCTURAL STEEL

HYDRAULIC PAINT

PROTECTS STEEL WATER PIPE and SUBMERGED STEEL

ACID RESISTING PAINT

PROTECTS BLAST FURNACES, SUGAR and PAPER MILLS, &c.

FROM CORROSION

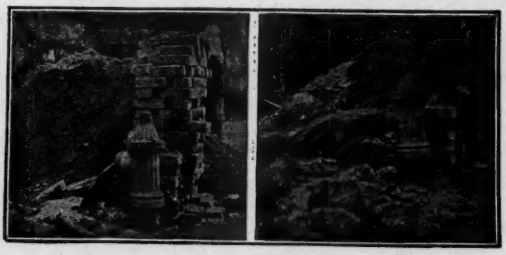
Write for Booklet W-44

SEMET-SOLVAY CO.

Syracuse, N. Y. Ensley, Ala. New York Chicago

Are You Getting Full Efficiency of Your Water Mains?

Before Cleaning



After Cleaning

July 13, 1907

Fire plug showing increased flow under same pressure at Wheeling, W. Va. :: For further particulars address

National Water Main Cleaning Co., 63 PARK ROW NEW YORK

WESTERN OFFICE:
MONADNOCK BLDG.
CHICAGO, ILL.

EASTERN OFFICE:
220 BROADWAY
NEW YORK CITY

FOR WATER AND GAS

McWane Pipe Works

MAIN OFFICE: LYNCHBURG, VA.

FOUNDRIES:

LYNCHBURG, VA. **RADFORD, VA.**

EMAUS PIPE FOUNDRY,
DONALDSON IRON CO.,

MANUFACTURERS
... OF ...

CAST IRON PIPE

... AND ..

Special Castings for Water and Gas.
Also Flange Pipe, Lamp Posts, Street Castings,
Manhole Heads and Covers, etc.

GEORGE ORMROD,
President and Treasurer.
J. G. EBERLEIN, Secretary.
JOHN D. ORMROD,
Vice-President and Superintendent.

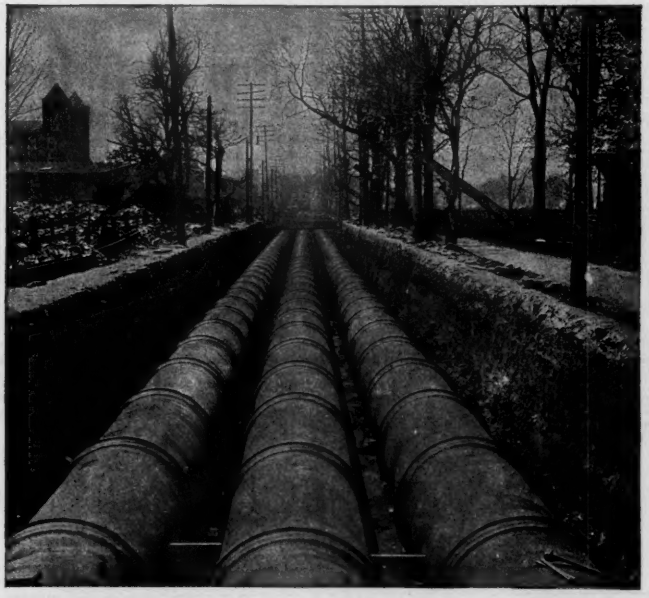
EMAUS,
LEHIGH COUNTY, PA.

CAST IRON PIPE

ALL REGULAR SIZES, 3 INCHES TO 84 INCHES

FOR WATER, GAS, SEWERS, DRAINS, ETC.

SEND FOR STANDARD SPECIFICATIONS



RAILROAD AND TURNPIKE CULVERTS

FLANGE PIPE AND FLANGE FITTINGS

HEAVY CASTINGS

AND THOSE MADE FROM ORIGINAL DESIGNS

United States Cast Iron Pipe and Foundry Company

GENERAL OFFICES, 71 BROADWAY, NEW YORK

Eastern Sales Office . . . 71 Broadway, New York
Western Sales Offices, 638 "The Rookery," Chicago, Ill.
Southern Sales Office . . . . Chattanooga, Tenn.
Pittsburgh Sales Office . . . . Murtland Building
Philadelphia Sales Office . . . Land Title Building

Service Boxes

The Chadbourne

Patented

The best of the Cast-Iron Boxes

The Stacy

The best of the Wrought-Iron Boxes

Complete description and price lists of each in Catalogue H
Globe Special Castings

Builders Iron Foundry
PROVIDENCE, R. I.

Chadwick-Boston Lead Co.

Corner Congress and Franklin Streets

162 Congress St. **BOSTON** **180 & 182 Franklin St.**

LEAD PIPE AND SHEET LEAD

Patent Tin-lined Pipe

Pure Block Tin Pipe

PIG LEAD

(Best Brands for Joint Work always in Stock)

Pig Tin, Wire Solder, Pumps, etc.

ALSO

"Forest River" and "Star" Brands

PURE WHITE LEAD

Eoco Gilsonite Paint

(Prepared under German Formulas)

Put this Paint on your Stand-Pipe, Pumps, Engines, Smoke Stack, Hydrants, brick, cement or wood-work, inside or outside your station; in fact, anything requiring Paint, then let us

Talk about it

It is Water proof and Heat proof; it is Elastic and will not crack; retains its gloss; is easily applied; has greater covering capacity; washed down with water it becomes fresh and bright. Just like new.

When applied according to directions, we give a guaranty that it will stand for five years. Paint with a

GUARANTY

is worthy of your consideration.

EOCO GILSONITE PAINT
THE PAINT OF NINE COLORS

Color card and price sent on request

Which will you buy?

Paint on a *Guess*, or
Paint on a *Guaranty?*

Eagle Oil & Supply Co.
Sole N. E. Agents
Address Paint Department
104 Broad Street BOSTON, MASS.

ENGINEERING NEWS

Founded 1874

The Leading Engineering Paper of the World

For Engineers, Architects, Draftsmen, Contractors, Manufacturers, Purchasing Agents, Government and Municipal Officials

Stands for progress, character and the highest ideals of the Engineering profession.

Covers the broad field of Engineering more comprehensively than any similar publication.

The most ably edited and most widely quoted technical journal in the world.

Nearly 2000 pages of text amply illustrated with photographs and drawings, and 450 pages of authentic Construction News notes.

The principal medium for "Situations Open," "Situation Wanted" and "Proposal" advertising.

Book Reviews in "Engineering Literature" Supplement, and Market Reports in "Current Prices of Engineering Materials."

A subscription is an investment — not an expense

ONE YEAR $5.00

A Sample Copy Sent on Request to Any Address.

Can You Afford to be Without the Most Important Journal Devoted to Your Profession?

"MUNICIPAL FRANCHISES"

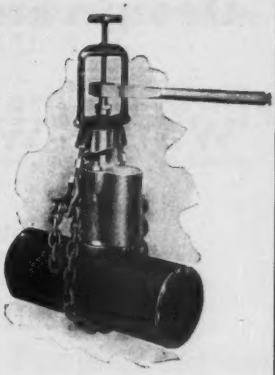
By DELOS F. WILCOX, Ph.D., Chief of the Bureau of Franchises, Public Service Commission, First District of New York

A valuable book which should be in the hands of every municipal official and engineer who comes in contact with franchise problems.

Price, $5.00 Postpaid. *Send for Table of Contents.*

The Engineering News Publishing Co.
220 Broadway . . New York City

Payne's Patent "NEW ECLIPSE" Tapping Machines

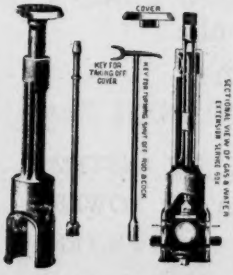


Do the best work, because they have

Few Working Parts
Compact
Simple in Construction
Light in Weight

We can prove these facts by sending a machine to you on thirty days' trial.

Long Main-End Corporation Cocks can be used



Makers of

High-Grade Water Works Brass Goods

to suit every requirement

Experience of hundreds of water companies has proven that original "HAYS-ERIE" SERVICE BOXES give the best satisfaction

Ask for Samples and Prices

Hays Manufacturing Co. **Erie, Penna.**

The Design and Construction of Water-Works Systems

and Novel Features in their Management are given careful attention by

THE Engineering Record

It also gives prominence to the following departments of a Water-Works System:

DAMS
AQUEDUCTS
PUMPING STATIONS
PIPE SYSTEMS
WATER TOWERS
FILTERS

SAMPLE COPIES FREE

Subscription Price, $3.00 a Year

ENGINEERING RECORD

239 WEST 39TH STREET NEW YORK

1881 1910

The Cook Well Co.

ST. LOUIS, MO., U. S. A.

Cook's System of Wells

For Cities, Towns, Villages, Railroads, Ice Plants, Breweries and Manufactories

Cook's Patent Brass Tube Well Strainer

Cook's Deep Well Pumping Engines

ESTIMATES FURNISHED UPON APPLICATION

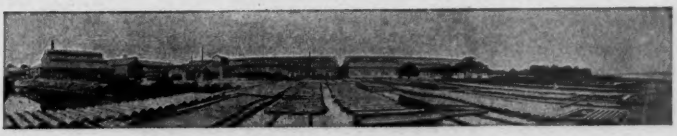
WRITE FOR CATALOGUE AND SAMPLES

STANDARD CAST IRON PIPE & FOUNDRY CO.

BRISTOL, PA.

CAST IRON PIPE AND SPECIAL CASTINGS

GENERAL FOUNDRY AND MACHINE WORK



PLANT LOCATED ON DELAWARE RIVER

Most Modern and Best Equipped Cast Iron Pipe Plant in America

Shipments made Either by Water or Rail

Twelve Reasons Why

YOU SHOULD USE

Trade "LEADITE" Mark

Registered U. S. Patent Office

FOR

Jointing Water Mains

1. **DURABILITY.** Leadite joints increase in strength with age.
2. **NO CAULKING.** Leadite joints require no caulking, because the Leadite adheres to the pipe, making a water-tight bond.
3. **COMPARATIVE QUANTITIES.** One ton of Leadite is equivalent to four tons of lead.
4. **LABOR SAVING.** Saves caulking charges and digging of large bell-holes, and reduces the cost of trench pumping to the minimum.
5. **COST.** Its use saves 50 to 65 per cent. over lead, owing to the saving effected in material and labor.
6. **TOOLS.** As no caulking is required, fewer tools are needed.
7. **TRANSPORTATION.** Considerable freight charges are saved because Leadite is lighter than lead.
8. **HAULING.** Saves hauling expense on the work because you move only one fourth the weight of jointing material.
9. **FUEL.** Saves fuel because you melt only one ton of material instead of four, and not as much heat is required either.
10. **DELIVERY.** We can make prompt shipments.
11. **DAMAGE SUITS.** Claims for damages caused by joints blowing out are prevented because Leadite joints will not blow out under any pressure.
12. **USERS.** Progressive water works all over the country use Leadite.

WRITE FOR BOOKLET

THE LEADITE COMPANY, Inc.

LAND TITLE BUILDING PHILADELPHIA

CLASSIFIED DIRECTORY OF ADVERTISEMENTS (*Continued*).

FILTERS AND WATER SOFTENING PLANTS. PAGE.

New York Continental Jewell Filtration Co. ix
Norwood Engineering Co. xv
Ross Valve M'f'g Co. xv

FURNACES, ETC.

H. Mueller Mfg. Co. x
Harold L. Bond & Co. xi
The A. P. Smith M'f'g Co. xiii
The Leadite Co. xxx

GAS ENGINES.

National Meter Co. iii

GATES, VALVES, AND HYDRANTS.

Ashton Valve Co. xv
Chapman Valve M'f'g Co. xviii
Coffin Valve Co. xvii
John Fox & Co. xiii
Ludlow Valve M'f'g Co. xvii
Norwood Engineering Co. xv
Rensselaer M'f'g Co. xix
Ross Valve M'f'g Co. xv
Simplex Valve and Meter Co. xi
The A. P. Smith M'f'g Co. xiii
R. D. Wood & Co. xvi

INSPECTION OF MATERIALS.

Wm. R. Conard xii

LEAD AND PIPE.

Chadwick-Boston Lead Co. xxiv
Lead Lined Iron Pipe Co. xiii

LEADITE.

The Leadite Co. xxx

METERS.

Buffalo Meter Co. xiv
Builders Iron Foundry xxiii
Hersey M'f'g Co. iv
National Meter Co. ii
Neptune Meter Co. vi
Pittsburg Meter Co. vii
Simplex Valve and Meter Co. xi
Thomson Meter Co. v
Union Water Meter Co. ix
Henry R. Worthington viii

METER BOXES.

H. W. Clark Co. xii
Hersey M'f'g Co. iv

OIL, GREASE, ETC.

Boston Engineers' Supply Co. xii
Jos. Dixon Crucible Co. xii
Eagle Oil and Supply Co. xxv

PACKING.

Harold L. Bond & Co. xi
Cancos M'f'g Co xii
Boston Engineers' Supply Co. xii
Eagle Oil and Supply Co. xxv

PAINT.

Eagle Oil and Supply Co. xxv
Semet-Solvay Co. xx

PIPE JOINTS.

The Leadite Co. xxx

PRESSURE REGULATORS.

H. Mueller Mfg. Co. x
Ross Valve M'f'g Co. xv
Simplex Valve and Meter Co. xi
Union Water Meter Co. ix

(*Index continued on page xxxii.*)

New England Water Works Association

STANDARD SPECIFICATIONS

FOR

Cast Iron Pipe

AND

Special Castings

Price 10 Cents

Address, WILLARD KENT, *Secretary*
715 Tremont Temple
BOSTON, MASS.

THE JULY ISSUE CONTAINS

Electrolysis of Underground Water System Structures in Pittsburgh

By E. E. LANPHER, Division Engineer, Bureau of Water

An extensive paper with discussion

PROCEEDINGS
THE ENGINEERS SOCIETY OF WESTERN PENNSYLVANIA

50 cents per copy **$5.00 per year**

ELMER K. HILES, Secretary **2511 Oliver Building, PITTSBURGH**

CLASSIFIED DIRECTORY OF ADVERTISEMENTS (*Concluded*).

	PAGE.
PUMPS AND PUMPING ENGINES.	
Builders Iron Foundry	xxiii
Cook Well Co.	xxix
National Meter Co.	iii
R. D. Wood & Co.	xvi
STRAINERS.	
Cook Well Co.	xxix
TAPPING MACHINES.	
H. Mueller Mfg. Co.	x
The A. P. Smith M'f'g Co.	xiii
TOOLS AND SUPPLIES.	
Boston Engineers' Supply Co.	xii
H. Mueller Mfg. Co.	x
Harold L. Bond & Co.	vi
H. W. Clark Co.	xii
The A. P. Smith M'f'g Co.	xiii
Hays M'f'g Co	xxvii
The Leadite Co.	xxx

The Journal of the New England Water Works Association

is a quarterly publication, containing the papers read at the meetings, together with verbatim reports of the discussions. Many of the contributions are from writers of the highest standing in their profession. It affords a convenient medium for the interchange of information and experience between the members, who are so widely separated as to find frequent meetings an impossibility. Its success has more than met the expectation of its projectors; there is a large and increasing demand for its issues, and every addition to its subscription list is a material aid in extending its field of usefulness. ALL MEMBERS OF THE ASSOCIATION RECEIVE THE JOURNAL IN PART RETURN FOR THEIR ANNUAL DUES; to all others the subscription is three dollars per annum.

TO ADVERTISERS

THE attention of parties dealing in goods used by Water Departments is called to the JOURNAL OF THE NEW ENGLAND WATER WORKS ASSOCIATION as an advertising medium.

Its subscribers include the principal WATER WORKS ENGINEERS and CONTRACTORS in the United States. The paid circulation is OVER 700 COPIES.

Being filled with original matter of the greatest interest to Water Works officials, it is PRESERVED and constantly REFERRED TO BY THEM, and advertisers are thus more certain to REACH BUYERS than by any other means.

The JOURNAL is not published as a means of revenue, advertisements being inserted solely to help meet the large expense of publication.

ADVERTISING RATES.

One page, one year, four insertions	Sixty Dollars.
One-half page, one year, four insertions	Forty Dollars.
One-fourth page, one year, four insertions	Twenty-five Dollars.
One-twelfth page (card), one year, four insertions	Ten Dollars.
One page, single insertion	Thirty Dollars.
One-half page, single insertion	Twenty Dollars.
One-fourth page, single insertion	Fifteen Dollars.

Size of page, 7¼ x 4¼ net.

A sample copy will be sent on application.

For further information, address,

ROBERT J. THOMAS,
Advertising Agent,
LOWELL,
MASS.

Or, RICHARD K. HALE,
Editor,
85 Water Street, Boston, Mass.